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SKINNER LANDFILL
West Chester, Butler County, Ohio

Remedial Design

**Final Design (100%)
Phase I Report**

Volume III of IV

May 20, 1996

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5.0 CONTRACTING STRATEGY

The work performed on the Skinner Landfill site generally falls into seven categories:

- Monitoring of surface and groundwater.
- Utility service extension/connection.
- Groundwater interception system installation.
- Sanitary Sewer discharge construction.
- Monitoring Well, Gas Probe, and Piezometer Installation.
- Contaminated Soil Excavation.
- Landfill capping, including earthwork and gas system, geosynthetics, and landscaping.

All seven of these areas require different skills for their overall construction. Additionally, the cap construction, the trench construction, and the contaminated soil excavation present the possibility that the contractors' personnel may be exposed to hazardous materials. As a result, the personnel working on these tasks will require appropriate health and safety training.

Currently, the planned location of the sanitary sewer discharge connection is such that it will be outside of the area where there is potential for workers to come in contact with hazardous materials. It is not expected that the excavation for the sanitary sewer discharge piping installation or the excavation required for the extension of utilities to the site, will present the potential for workers to be exposed to hazardous materials.

The seven areas of work defined above can in large part be accomplished independently of each other. There is a certain sequence of construction that will be required, in order that the performance of one task does not interfere with or damage prior construction. The general sequence of construction is the order of the above listed areas. The different areas of construction are sufficiently independent or separate such that they may be performed as separate construction contracts.

Based on the above information, it is possible that there be six separate contracts for the remedial actions at the Skinner Landfill Site. However, due to the need to interface between certain key aspects, we recommend that the four separate contracts, with the work for each contract as defined below.

Contract 1	Utility Service extension/Connection Groundwater Interception System Sanitary Sewer Discharge Construction
Contract 2	Monitoring Well and Piezometer Installation Monitoring of surface and Groundwater Gas Probe installation
Contract 3	Contaminated Soil Excavation

Contract 4	Landfill Capping - Earthwork
Contract 5	Geosynthetic Installation
Contract 6	Landscaping

Any site restoration required as a result of the work to be performed in each contract, will be the responsibility of the contractor performing the work for that contract.

A separate contract(s) will be required for the Construction Quality Assurance for the trench and cap construction. This contract will need to be a prime contract.

A contract will also be required for the land surveying work to be performed on-site. This firm should be retained to provide baselines on the site from which the various contractors can work. Additionally, the site surveyor should be retained to perform any survey work required for the verification of the cap construction limits and thicknesses. The surveyor will also be used to spot check the depth of the trench construction as defined in the CQAP.

For the monitoring well, piezometer, and gas probe installation, a separate contract is recommended. This contract should be combined with the contract for the monitoring effort due to the close link between the first round of groundwater monitoring and the installation of the monitoring wells.

The services of an overall Project Manager/site coordinator/administrator would be desirable for this project. This will provide for the implementor's representation on-site during construction. Tasks for this person will include: coordination of construction issues with the engineer and CQA firm and contractor, status reporting of the field work, verification of contractors' invoices, monitoring of the contractors' compliance with the contract, and dealing with the public when required.

5.1 Construction Schedule




A draft construction schedule is attached as Figure 5-1.

Figures

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[illegible]

-  - Action Period
-  - Milestone Event
-  - Total Task Duration

[illegible]

- FIGURE 5.1 CONTINUED

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6.0 REMEDIAL ACTION WORK PLAN

Section III.c. of the SOW requires that a Draft Remedial Action Work Plan be submitted as a component of the final (100%) design. The plan is required to include a detailed description of the remedial and construction activities, and a project schedule for each major activity and submission of deliverables generated during the Remedial Action. The Draft Remedial Action Work Plan is provided in Volume IV as Support Plan H.

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7.0 COST ESTIMATE FOR REMEDIAL ACTION

Tables 7.1 through 7.4 reflect the development of costs for implementation of the Remedial Action. Costs are broken into capital (construction and associated labor and equipment) and operating (annualized or recurring) costs. Monitoring and analytical costs are broken out from the operating cost estimate to more accurately determine these values. To account for uncertainty and the level of this estimate, a 20% contingency factor has been added to the estimates. The operating costs have been converted into 1996 dollars over a 30 year life using a 5% escalation factor and added to the capital costs to develop a total net present worth cost.

Tables

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SKINNER LANDFILL REMEDIAL DESIGN**TABLE 7.1****COST ESTIMATE SUMMARY**

I. Capital Costs	
A. Monitoring Wells and Piezometers	\$100,000
B. Groundwater Interception System	\$805,000
C. Landfill Final Cover	\$3,370,000
Subtotal	\$4,275,000
II. Operation and Maintenance Costs	
A. Monitor Wells and Piezometers	\$148,000
B. Interception System	\$254,000
C. Landfill Cover	\$336,000
Subtotal	\$738,000
III. Monitoring and Analytical	
A. During Remedial Action	\$510,000
B. Post Remedial Action	\$3,536,000
Subtotal	\$4,046,000
Total	\$9,059,000

TOTAL ESTIMATED COST**FOR REMEDIAL ACTION \$9,100,000**

SKINNER LANDFILL REMEDIAL DESIGN

TABLE 7.2

I. Capital Costs

A. Monitoring Wells and Piezometers

No.	Item	Quantity	Units	Price	Costs
1	Well Abandonment*	1	LS	\$50,000	\$50,000
2	Well and Piezometer Drilling	1	LS	\$20,000	\$20,000
3	Well Installation-10 installed	170	LF	\$13.70	\$2,329
4	Piezometer Installation-12 installed	386	LF	\$10.95	\$4,227
5	Well Bailer	10	EA	\$200	\$2,000
Subtotal					\$78,556

6	Contingency (20%)				\$15,711
7	Rounding				\$5,733

Monitor Wells and Piezometers Total - Construction					\$100,000
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* Expenses Associated with Well Abandonment

B. Groundwater Interception System

B.1. Site Preparation, Clearing, Restoration

No.	Item	Quantity	Units	Price	Costs
8	Heavy Clearing and Grubbing	1	ACRE	\$1,000	\$1,000
9	Light Clearing and Grubbing	1	ACRE	\$300	\$300
10	Fence/Gate Relocation	250	LF	\$23.25	\$5,813
11	Berm Construction	310	CY	\$5.75	\$1,783
12	Platform Grading	1,364	CY	\$2.00	\$2,728
13	Final New Fence Installation	100	LF	\$12.60	\$1,260
14	Riprap for Slope Stability- 3' thick	585	TON	\$150	\$87,750
15	Erosion Mat for Slope	200	SY	\$1.50	\$300
16	Site Regrading	1,364	CY	\$2.00	\$2,728
17	Seeding, Fertilizing, & Mulching	37	MSF	\$17.95	\$661
Subtotal					\$104,322

TABLE 7.2 (cont'd)

B.2. Interception System

No.	Item	Quantity	Units	Price	Costs
18	Collection Trench	12,000	SF	\$15.00	\$180,000
19	Cut-off Wall	14700	SF	\$10.00	\$147,000
20	Keying Trench into bedrock	600	SF	\$15.00	\$9,000
21	Excavate Lead in Trench for Pouring Slurry	225	CY	\$5.30	\$1,193
22	Extraction Well Manholes-4' dia., 4' deep	3	EA	\$685	\$2,055
23	Inspection Manholes - 4' dia.	1	EA	\$2,222	\$2,222
24	Vacuum/Air Release Manhole - 4' dia., 8' deep	1	EA	\$1,975	\$1,975
25	Force Main Valve Vault - 5'x5'x4.5'	1	EA	\$2,750	\$2,750
26	Gravity Flow Manhole - 4' dia., 9' deep	1	EA	\$2,222	\$2,222
27	2" dia. HDPE force main	970	LF	\$30	\$29,100
28	2" dia. HDPE force main with 4" PVC secondary wall	170	LF	\$30	\$5,100
29	8" dia. PVC Observation Wells @ 100' spacing - 9 Well	135	LF	\$20	\$2,700
30	8" dia. PVC Extraction Wells - 3 Wells	45	LF	\$20	\$900
31	8" dia. HDPE Gravity Sewer Line	35	LF	\$30	\$1,050
32	Tie in to Existing Manhole (Allowance)	1	LS	\$2,000	\$2,000
33	Butler County Volumetric Fee per 1000 gal discharge	11	GPD/1000	\$0.85	\$9
34	Butler County Fixed Industrial Discharge Fee	1	LS	\$2	\$2
35	Pumps-Submersible, 25 gpm @ 55 TDH, Single Phase	3	EA	\$856	\$2,568
36	Flow Discharge Connection (QDC) for 1" Guiderail	1	EA	\$207	\$207
37	Flow Meter	1	EA	\$3,000	\$3,000
38	Continuous Sampler	1	EA	\$2,500	\$2,500
39	Main Control Panel	1	EA	\$5,000	\$5,000
40	Well-3 Point Level Controls	3	EA	\$510	\$1,530
41	Telephone Autodialer	1	EA	\$1,000	\$1,000
42	Power Wiring (Allow)	1	LS	\$10,000	\$10,000
43	Control Wiring (Allow)	1	LS	\$10,000	\$10,000
44	Local Pump Control Panel	4	EA	\$2,000	\$8,000
45	Systems Testing (Allow)	1	LS	\$10,000	\$10,000
Subtotal					\$443,083

TABLE 7.2 (cont'd)**B.3. Utility Service Connection**

No.	Item	Quantity	Units	Price	Costs
46	Telephone Pole - 25' tall	1	EA	\$730	\$730
47	Utility Trench Excavation	441	CY	\$4.41	\$1,945
48	Backfill - from borrow	441	CY	\$4.98	\$2,196
49	Concrete Driveway Removal	2	CY	\$84.00	\$168
50	Saw Cutting Concrete	40	LF	\$3.17	\$127
51	Replace Concrete Paving - 8" thick	5	SY	\$24.00	\$108
52					
Subtotal					\$5,274

B.4. Other Site Activities

No.	Item	Quantity	Units	Price	Costs
53	Temporary Facilities	8	MONTH	\$2,000	\$16,000
54	Mobilization and Demobilization	1	LS	\$100,000	\$100,000
Subtotal					\$116,000

55	Contingency (20%)				\$133,736
56	Rounding				\$2,586

Interception System Total - Construction					\$805,000
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C. Landfill Final Cover**C.1. Site Preparation, Clearing, Subgrade, Capping**

No.	Item	Quantity	Units	Price	Costs
1	Heavy Clearing & Grubbing	5	ACRE	\$1,000	\$5,000
2	Light Clearing & Grubbing	10	ACRE	\$300	\$3,000
3	Access Road	500	SY	\$15.00	\$7,500
4	Waste Adjustments (Cuts & Fill)	6,000	CY	\$10.00	\$60,000
5	Subbase Grade General Earth Fill	35,000	CY	\$5.00	\$175,000
6	Surface Preparation	50,820	SY	\$2.00	\$101,640
7	Geosynthetic Gas Venting Layer	50,820	SY	\$6.00	\$304,920
8	Compacted Cohesive Soil Barrier Layer (18 inches)	25,410	CY	\$15.00	\$381,150
9	Geosynthetic Clay Layer	50,820	SY	\$6.00	\$304,920
10	Geomembrane Layer (40 mil textured FML)	50,820	SY	\$7.20	\$365,904
11	Geocomposite Drainage Layer	50,820	SY	\$5.00	\$254,100
12	Cover Soil Layer (30 inches)	42,350	CY	\$5.00	\$211,750
13	Seeding, Fertilizing, & Mulching	50,820	SY	\$0.40	\$20,328
Subtotal					\$2,195,212

TABLE 7.2 (cont'd)**C.2. Gas Control System**

No.	Item	Quantity	Units	Price	Costs
14	Passive Gas Vent	15	EA	\$500	\$7,500
15	Gas Monitoring Probe	250	LF	\$25.00	\$6,250
Subtotal					\$13,750

C.3. Surface Water Drainage Control

No.	Item	Quantity	Units	Price	Costs
16	Drainage Swale Excavations	5,000	CY	\$3.00	\$15,000
17	Drainage Swale Fine Grading	9,000	SY	\$2.00	\$18,000
18	Riprap Flumes	200	TONS	\$150	\$30,000
19	Erosion Matting	9,000	SY	\$1.00	\$9,000
20	Silt Fencing	10,000	LF	\$1.00	\$10,000
21	Ditch Checks	10	EA	\$250	\$2,500
22	Culvert Pipes	60	LF	\$10.00	\$600
Subtotal					\$85,100

C.4. Contaminated Soil Excavation and Disposal

No.	Item	Quantity	Units	Price	Costs
23	Soil Excavation, Transport, & Disposal	875	CY	\$5.00	\$4,375
24	Backfill Excavation	875	CY	\$5.00	\$4,375
Subtotal					\$8,750

C.5. Other Site Activities

No.	Item	Quantity	Units	Price	Costs
25	Fencing Relocation	3,000	LF	\$5.00	\$15,000
26	Decontamination Pad	1	EA	\$10,000	\$10,000
27	Borrow Area Restoration	20,000	SY	\$2.00	\$40,000
28	Temporary Facilities	8	MONTH	\$2,000	\$16,000
29	Mobilization & Demobilization (5%)	1	LS	\$100,000	\$100,000
30	CQA monitoring with testing and report	8	MONTH	\$40,000	\$320,000
Subtotal					\$501,000

31	Contingency (20%)				\$560,762
32	Rounding				\$5,426

Final Cover Total - Construction					\$3,370,000
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Total - Capital Costs					\$4,275,000
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SKINNER LANDFILL REMEDIAL DESIGN**TABLE 7.3****II. Operation & Maintenance Costs****A. Monitoring Wells and Piezometers**

1. Inspections	Quarterly Inspections	
	8 hours @ \$50/hr for inspector	\$400
	1 hour @ \$25/hr for word processor	\$25
	Miscellaneous expenses	\$50
	Subtotal	\$475
	Annual Inspection Cost = 4 inspections @\$475 each	\$1,900
2. Well Repairs	Replace 10 bailers every 10 years	
	10 @ \$200 /bailer/10 years	\$200
	Well and piezometer repair allowance per year	\$2,500
	Miscellaneous expenses	\$200
	Subtotal	\$2,900
3. Annual Report	40 hours @ \$75/hr to assemble report	\$3,000
	4 hour @ \$25/hr for word processor	\$100
	Miscellaneous expenses	\$100
	Subtotal	\$3,200
	Subtotal	\$8,000
	Contingency (20%)	\$1,600
	ANNUAL POST CLOSURE O&M COST TOTAL	\$9,600
Present Value	P/F @ 5% for 30 Years = Total * 15.3725 (Rounded)	\$148,000

TABLE 7.3 (cont'd)

B. Interception Trench System

1. Inspections	Monthly Inspections	
	8 hours @ \$50/hr for inspector	\$400
	1 hour @ \$25/hr for word processor	\$25
	Miscellaneous expenses	\$50
	Subtotal	\$475
	Annual Inspection Cost = 12 inspections @\$475 each	\$5,700
2. Equipment Repairs	Replace one pump every 5 years	
	1 @ \$1000/pump/5 years	\$200
	Replace one flowmeter every 5 years	
	1 @ \$3000/flowmeter/5 years	\$600
	Replace one continuous sampler every 5 years	
	1 @ \$2500/sampler/5 years	\$500
	Replace one group of 3 point level controls every 5 years	
	1 group of 3 controls @ \$1530/3 controls/5 years	\$310
	Replace telephone autodialer once every 10 years	
	1 @ \$1000/autodialer/10 years	\$100
	Control panel repair allowance per year	\$200
	Miscellaneous expenses	\$200
	Subtotal	\$2,110
3. Electrical	One billing statement per month @ \$200/bill	\$2,400
4. Telephone	One billing statement per month @ \$30/bill	\$360
	Subtotal	\$2,760
5. Annual Report	40 hours @ \$75/hr to assemble report	\$3,000
	4 hour @ \$25/hr for word processor	\$100
	Miscellaneous expenses	\$100
	Subtotal	\$3,200
	Subtotal	\$13,770
	Contingency (20%)	\$2,750
	ANNUAL POST CLOSURE O&M COST TOTAL	\$16,520
Present Value	P/F @ 5% for 30 Years = Total * 15.3725 (Rounded)	\$254,000

TABLE 7.3 (cont'd)

C. Landfill Cover, Surface Drainage, and Gas Control

1. Inspections	Quarterly Inspections	
	8 hours @ \$50/hr for inspector	\$400
	1 hour @ \$25/hr for word processor	\$25
	Miscellaneous expenses	\$50
	Subtotal	\$475
	Annual Inspection Cost = 4 inspections @\$475 each	\$1,900
2. Cover Repairs	Assume 1/2 acre needs repair per year	
	Vegetative Cover Soil	
	43560 sf/acre * 0.5 acre * 1 ft cover / 27cf/cy * \$5.00/cy	\$4,030
	Vegetative Cover	
	43560 sf/acre * 0.5 acre / 9sf/sy * \$0.40/sy	\$970
	Erosion Blanket	
	43560 sf/acre * 0.5 acre / 9sf/sy * \$0.50/sy	\$1,210
	Documentation Report	
	8 hours @ \$50/hr for inspector	\$400
	1 hour @ \$25/hr for word processor	\$25
	Miscellaneous expenses	\$50
	Subtotal	\$6,685
3. Annual Mowing	10.5 acres @ \$200 per acre	\$2,100
4. Fencing Repairs	100 lf of fence @ \$10 per lf	\$1,000
5. Gas Vents	Replace 1 turbine vent per year @ \$50 each	\$50
6. Gas Probe	Replace 1 probe every 5 years	
	20 lf @ \$50/lf / 5 years	\$200
7. Gas Monitoring	8 hours @ \$50/hr to take readings 4 times per year	\$1,600
	1 hour @ \$25/hr for word processor 4 times per year	\$100
	Miscellaneous expenses @ \$50 per monitoring event	\$200
	Subtotal	\$1,900
8. Sediment Control	Cleanout silt from control devices	
	Assume 200 ft of swale @ .25 cy/lf needs cleaning	
	200 lf * 0.25 cy/lf @ \$15.00/cy	\$750
	Restore swale vegetation and erosion matting	
	200 lf * 12 ft / 9sf/sy * \$1.50/sy	\$400
9. Annual Report	40 hours @ \$75/hr to assemble report	\$3,000
	4 hour @ \$25/hr for word processor	\$100
	Miscellaneous expenses	\$100
	Subtotal	\$3,200
	Subtotal	\$18,185
	Contingency (20%)	\$3,640
	ANNUAL POST CLOSURE O&M COST TOTAL	\$21,825
Present Value	P/F @ 5% for 30 Years = Total * 15.3725 (Rounded)	\$336,000
Total - Operation and Maintenance Costs*		\$738,000

* Numbers rounded to reflect estimated accuracy.

SKINNER LANDFILL REMEDIAL DESIGN

TABLE 7.4

III. Analytical Costs

A. Monitoring and Analysis During Remedial Action

1. Soil Analysis*

No.	Item	Quantity	Units	Price	Costs
1	Analytical				\$11,800
2	Labor				\$9,350
3	Miscellaneous expenses**				\$100
Subtotal					\$21,250

2. Surface Water Monitoring from Discharge Points***

No.	Item	Quantity	Units	Price	Costs
4	Analytical				\$71,400
5	Labor				\$54,220
6	Equipment				\$750
7	Miscellaneous				\$800
Subtotal					\$127,170

3. Surface Water Monitoring for Creeks****

No.	Item	Quantity	Units	Price	Costs
8	Analytical				\$97,360
9	Labor				\$72,750
10	Equipment				\$800
11	Miscellaneous				\$1,230
Subtotal					\$172,140

4. Groundwater Monitoring*****

No.	Item	Quantity	Units	Price	Costs
12	Analytical				\$15,835
13	Labor				\$17,420
14	Equipment				\$75
15	Miscellaneous				\$300
Subtotal					\$33,630

5. Biological Sampling

No.	Item	Quantity	Units	Price	Costs
16	Field Survey Spring - Construction Phase				\$4,215
17	Field Survey Summer - Construction Phase				\$4,215
18	Field Survey Fall - Construction Phase				\$4,215
19	Field Survey Spring - Post Construction				\$4,215
20	Field Survey Summer - Post Construction				\$4,215
21	Field Survey Fall - Post Construction				\$4,215
22	Laboratory Analyses - All Sampling Events				\$37,000
23	Summary Report of Findings				\$3,865
Subtotal					\$66,155

6. Air Monitoring

No.	Item	Quantity	Units	Price	Costs
24	Analytical				\$13,000
25	Labor				\$54,120
26	Equipment				\$17,500
27	Miscellaneous				\$800
Subtotal					\$85,420

24	Contingency (20%)				\$84,069
25	Rounding				\$5,586

Total Cost During Remedial Action					\$510,000
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* Soil analysis is to be done one time only.

** Equipment costs and other capital costs are detailed in the Capital Costs section.

*** Results are indicative of 15 sampling events.

**** Results are indicative of 16 sampling events.

***** Results are indicative of one sampling event.

TABLE 7.4 (cont'd)

B. Monitoring and Analysis Post Construction Remedial Action**1. Surface Water Monitoring for Creeks***

No.	Item	Quantity	Units	Price	Costs
1	Analytical				\$45,000
2	Labor				\$25,000
3	Equipment				\$1,600
4	Miscellaneous				\$3,700
Subtotal					\$75,300

2. Groundwater Monitoring*

No.	Item	Quantity	Units	Price	Costs
5	Analytical				\$16,000
6	Labor				\$65,000
7	Equipment				\$1,800
8	Miscellaneous				\$15,500
Subtotal					\$98,300

3. Sanitary Sewer Sampling*(1)

No.	Item	Quantity	Units	Price	Costs
9	Analytical				\$2,400
10	Labor				\$5,800
11	Equipment				\$900
12	Miscellaneous				\$7,300
Subtotal					\$16,400

13	Contingency (20%)				\$38,000
14	Rounding				\$2,000

Total Annual Post Construction Remedial Action Cost					\$230,000
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Present Value	P/F @ 5% for 30 Years = Total * 15.3725 (Rounded)				\$3,536,000
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Total Post Remedial Action Cost					\$3,536,000
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Total Monitoring and Analytical Costs**					\$4,046,000
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*Results are on an annual basis

** Numbers rounded to reflect estimated accuracy

(1) Estimated, pending issuance of permit by BCDES

8.0 SUPPORTING PLANS FOR RA AND IMPLEMENTATION

The supporting plans for the remedial action include: the QAPjP, FSP, HASP, SPCC, AMP, CP, LTPP, RAWP, CQAP, and O&M Plan. These plans are included in Volume IV.

8.1 Quality Assurance Project Plans (QAPjP)

The United States Environmental Protection Agency (U.S. EPA) requires that all environmental monitoring and measurement efforts mandated or supported by U.S. EPA participate in a centrally managed quality assurance (QA) program.

Any party generating data under this program has the responsibility to implement minimum procedures to assure that the precision, accuracy, completeness, and representativeness of its data are known and documented. To ensure the responsibility is uniformly met, each party must prepare a written QA Project Plan (QAPjP) covering each project it is to perform.

The QAPjP presents the organization, objectives, functional activities and specific QA and the quality control (QC) activities associated with the remedial design (RD) efforts at the Skinner Landfill Site. The QAPjP also describes the specific protocols that will be followed for sampling, sample handling and storage, chain-of-custody, and field and laboratory analysis.

All QA/QC procedures will be in accordance with applicable professional technical standards, U.S. EPA requirements, government regulation and guidelines, and specific project goals and requirements.

The QAPjP, presented as Support Plan A in Volume IV of this submittal, is prepared in accordance with all U.S. EPA QAPjP guidance documents including Contract Laboratory Program (CLP) guidelines, Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (QAMS-005/80), the U.S. EPA Region V Model QAPjP (1991), and Model Mini-QAPjP (1993).

8.2 Field Sampling Plan (FSP)

The Field Sampling Plan (FSP) is an integral part of the RD QAPjP and consolidates the sampling requirements for use by the field personnel. This plan includes the site-specific sampling plans, sampling procedures and methodologies, site plans, and details of the sampling levels of effort.

Throughout the document, Standard Operating Procedures (SOPs) are referenced. These SOPs define the general sampling methodologies and procedures that will be followed during remediation activities.

The FSP for remedial activities is presented as Support Plan B in Volume IV of this submittal.

8.3 Health and Safety Plan (HASP)

The site-specific Health and Safety Plan (HASP) has been prepared for the Skinner Landfill Site in accordance with the regulatory requirements of 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response", 29 CFR 1926.59 for construction, and with the AOC, dated March 29, 1994, between the United States Environmental Protection Agency (U.S. EPA) and the Potentially Responsible Parties (PRP). The HASP covers field activities and investigations being performed as part of the remedial activities of the selected remedy for the Skinner Landfill Site.

The purposes of the HASP are to summarize the project organization and responsibilities; establish Standard Operating Procedures (SOPs) for preventing accidents, injuries, and illnesses; identify hazards; discuss the personal protective equipment that may be used at the site; identify personnel health and safety training requirements; summarize the monitoring techniques to be used; establish emergency procedures; describe the medical surveillance program; identify that appropriate first aid equipment is available; provide for accident recordkeeping; and establish a schedule for safety inspections.

The HASP is presented as Support Plan C in Volume IV of this submittal.

8.4 Spill Prevention Control and Countermeasure Plan (SPCC)

A Spill Prevention Control and Countermeasure Plan (SPCC) has been developed for the purpose of providing guidelines in the event of a spill during the remedial actions or subsequent monitoring activities. The plan covers spill procedures, notification procedures, and spill prevention methods. The SPCC is presented as Support Plan D in Volume IV of this submittal.

8.5 Air Monitoring Plan (AMP)

An Air Monitoring Plan (AMP) has been developed for field activities to be conducted during remedial activities at the site. The plan includes methods for airborne contaminant migration control as well as methods and procedures for perimeter, personnel, and real-time air monitoring during site activities. The AMP is presented as Support Plan E in Volume IV of this submittal.

8.6 Contingency Plan

A Contingency and Emergency Preparedness plan has been developed for emergency occurrences that may arise on-site during remedial activities. The plan addresses responsibilities of plan implementation, emergency service contacts and protocols for implementation of the plan. Types of emergencies addressed in the plan include fires and explosions, serious personal injury, chemical exposure, release of hazardous materials and unsafe working conditions. The Contingency Plan is presented as Support Plan F in Volume IV of this submittal.

8.7 Long-Term Performance Plan

A Long-Term Performance Plan (LTPP) has been prepared that provides the mechanism to assess whether both short-term and long-term remedial actions meet the performance standards set forth in the ROD and SOW. The performance standards include cleanup standards, quality criteria and other substantive requirements, criteria or limitations, and ARARS set forth in the ROD, SOW, and/or AOC, where appropriate. The LTPP begins after the last sampling event of the RA, and will use the results of this event as a base line for assessing the RA's. The LTPP is presented as Support Plan I in Volume IV of this submittal.

The resulting data will be used by the PRPs, or their consultant, to modify the system as may be required to enhance its effectiveness. The LTPP is presented as Support Plan G in Volume IV of this submittal.

8.8 Remedial Action Work Plan

A Draft Remedial Action Work Plan (RAWP) has been prepared that includes a detailed description of the remedial and construction activities, and a project schedule for each major activity and submission of deliverables generated during the Remedial Action. The Draft RAWP is presented as Support Plan H in Volume IV of this submittal.

8.9 Construction Quality Assurance Plan

A Construction Quality Assurance Plan (CQAP) has been prepared that describes the procedures for assuring that construction activities conducted on the site are performed in accordance with project specifications. The CQAP is presented as Support Plan I in Volume IV of this submittal.

8.10 Operations & Maintenance Plan

An Operations & Maintenance Plan (O&M Plan) has been prepared that describes the active operations and periodic maintenance that must be performed after construction activities are complete. The O&M Plan is presented as Support Plan J in Volume IV of this submittal.

9.0 LONG TERM SITE MANAGEMENT AND PERFORMANCE MONITORING

The SOW requires development of documents and procedures to be used during and after completion of the RA to ensure the site does not further impact human health and the environment. This section describes the required monitoring and maintenance programs. Plans for implementation of these programs are included in this section as part of the Pre-Final Design.

9.1 Institutional Controls

Section II.b. of the SOW requires the Respondents to propose a legal strategy for the attainment of effective institutional controls to limit the future use of all areas of the site where remedial construction has occurred.

The SOW requires that institutional controls be implemented to assure that exposure to waste materials that are contaminated is restricted. The SOW states: *"The restrictions shall prevent the use of this portion of the site for any activity which would interfere with the performance of the remedy, or which would result in the exposure of contaminants to humans or the environment. Such activities include residential or recreational use, excavation, or construction of wells. The Respondents shall seek to prevent all individuals from traversing the cap, once completed, so that the cap will not be damaged"*. This section presents a discussion of the measures that will be utilized to control access and for exposure control. The measures to be implemented include physical barriers for access control and deed restrictions and zoning for exposure control.

While the SOW indicates specific elements with respect to limited or prohibited activities, alternatives that seek to use the site productively in the future should also be evaluated.

9.1.1 Access Control

The primary barrier to be established will include a fence with a locking gate around the perimeter of the portion of the site where the remedy is implemented. A fence currently exists around essentially the same area and is inspected on a bi-weekly basis as a component of the interim remedial measures conducted on the site. Where possible, the current fence will be maintained in place. In some areas, earth movement or reestablishment of the slope may require relocation of the fence. Temporary fencing may need to be established while work is being conducted. Upon completion of site remediation activities, a permanent fence with locking gates will be reestablished around the entire remediated area. Access will be restricted to those involved in long-term maintenance, as appropriate. The fence integrity will be inspected on a regular basis and damages or breaches in the fence will be repaired. Signage will be maintained as defined in Section II.a of the SOW. The frequency of the fence inspection and access limitations will be reviewed periodically.

9.1.2 Exposure Control

Deed restrictions for the remediated portion of the site will be sought to control future use activities. Specifically, the deed restrictions will include a prohibition on development for residential use. Restrictions will also be sought for subsurface or surface intrusions such as drilling, grading, disturbance of cover vegetation, etc., that could compromise the effectiveness of the remedial activities implemented. Establishment of drinking water wells will also be prohibited.

The property zoning is currently unknown. A request will be made to the Union Township Zoning Board to define the zoning and establish a zoning designation for the remediated portion of the site to prohibit change of zoning to any designation that could involve residential use.

9.2 Groundwater Monitoring

Section II.g.1. of the SOW requires the Final Design to include specifications for a long-term program to monitor the effectiveness of the remedy in terms of groundwater protection. The monitoring system will also be required to test for the possible presence and/or movement of Dense, Non-Aqueous Phase Liquids (DNAPLs) in the vicinity of the buried waste lagoon area, even though no DNAPLs have been identified in the extensive testing performed to date. Further, wells designated as representing the points of compliance or compliance boundaries will be specified. Finally, measurement of water levels will be evaluated to determine the effectiveness of the cap.

This monitoring program is part of the LTPP, which is included as Support Plan G in Volume IV.

9.3 Surface Water Monitoring

Section II.g.2 of the SOW requires a Surface Water Monitoring Plan as part of the design that addresses the testing of surface waters during construction and over the long term. Baseline characterization of the surface water was performed as part of the GWDI.

This monitoring plan is included in the LTPP, which is included as Support Plan G in Volume IV of this submittal.

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10.0 OPERATION

The remedial actions that will require active operation and periodic maintenance after the construction is complete are the landfill cover, the interception trench, and groundwater discharge sampling system. For purposes of this section, operation will be the activities required to maintain the effectiveness of the remedies. The remedies will be discussed separately below; however, the operation of these remedies will be performed in concert with each other.

10.1 Landfill Cover Operation

The landfill consists of approximately 10.5 acres. The landfill cover serves as a low permeability cover for the landfill and buried lagoon. The purpose of the cover is to minimize the infiltration of water into the landfill and lagoon, and thus keep to a minimum the amount of water that comes in contact with the waste. (The interception system attends to the groundwater contact the waste.)

In order to maintain the effectiveness of the Cover, quarterly site inspections will be performed. These inspections will specifically look for:

- refuse subsidence,
- drainage control system problems (erosion),
- distressed vegetation, and
- animal intrusion.

A quarterly report will be prepared that will document the inspection activities.

Any problems identified will be documented in detail and reported to the Project Manager within a week of the inspection activities. Subsequently, a report will be prepared that will document the condition(s) and recommend the remedial actions. Where the integrity of the Cap is considered to be compromised (for more than small isolated areas), a corrective action will be initiated to address the situation within two months of the inspection. In the event that the repair or action will be impaired by weather, the project manager will advise U.S. EPA in writing, and effect the repair as soon as weather permits. In no case will repairs be attempted in conditions that could cause further damage to the cover as a result of the equipment traffic conducting the repair.

As part of the operation of the landfill, the vegetation will be mowed once per year. The mowing operation will be performed to control the growth of weeds. The mowing will be timed such that the quarterly inspections are coordinated with the mowing to facilitate a better situation for the inspection.

The gas vents will also be inspected to be sure that there are no blockages that could inhibit the flow of gas through the vent. Most of the problems anticipated will be able to be corrected by the personnel performing the inspections. Corrective actions will be taken as indicated for the cover above.

10.2 Interception System

The primary operating components of the interception system are three sections of interceptor trench, the three extraction wells and the associated force main. The purpose of the interception system is to intercept and collect groundwater before it reaches the East Fork of Mill Creek.

In order to maintain the effectiveness of the interception system, the operation of the groundwater extraction portion of the system must be maintained. The key components in the system are the extraction wells (pump and piping). During the first six months of operation, the system will be inspected monthly. This will allow for the refinement in the levels of the control switches for the pumps.

After the first six months, the system will have reached a normal operating level, and any further adjustment should be minimal. During the scheduled inspections, the operation of each pump will be checked. A spare pump will be kept in storage in the event a pump goes down.

An alarm system will be installed for each pump to identify conditions that would indicate an operating problem with the extraction wells. Alarm status will be indicated by phone call to a predetermined person(s). The system is designed such that there will be ample time to respond and take corrective action before levels of groundwater rise to a critical level in the interceptor trench.

Reporting of alarm conditions and corrective actions will be incorporated in the quarterly inspection report(s). The Project Manager will be notified of any alarm conditions and the response required within a day of the occurrence.

All of the other operating features of the interception system will be inspected during the regularly scheduled inspection events (monthly the first six months, quarterly thereafter).

10.3 Groundwater Discharge Sampling

The authorization to discharge issued by Butler County Department of Environmental Services (BCDES) to allow discharge of extracted groundwater to the sanitary sewer will likely include requirements to monitor the flow discharged and periodically sample and analyze the wastewater. To comply with this anticipated requirement, a flow measurement and sampling manhole will be installed. The flow meter and sampler will be checked to verify operability each time a sampling event is initiated. The frequency of sampling events will be determined by the authorization to discharge issued by BCDES. Calibration of the flow meter will be performed on a schedule according to the manufacturer's specifications, or if observation or comparison with pump run times indicates the flow meter may not be functioning properly.

The operations and maintenance events are further defined in the Operations and Maintenance manual.

SPECS

DIVISION 1 - GENERAL REQUIREMENTS

LIST OF SPECIFICATIONS

Division 01

01010	Summary of Work
01025	Measurements and Payments
01030	Alternate Bid Items
01041	Project Coordination
01050	Construction Staking
01155	On-site Health and Safety Requirements
01200	Project Meetings
01310	Construction Progress Schedules
01340	Submittals
01370	Schedule of Values
01380	Construction Photographs
01410	Testing Laboratory Services
01500	Temporary Construction Facilities and Utilities
01560	Protection of Environment
01600	Materials and Equipment
01669	Testing Piping Systems
01670	Systems Demonstrations
01720	Project Record Documents
01730	Operation and Maintenance (O&M) Data
01737	Electrical System Demonstrations

Division 02

02100	Site Preparation and Maintenance
02210	Site Grading
02221	Trenching, Backfilling, and Compacting
02224	Excavation, Backfilling, and Compacting
02243	Landfill Subgrade
02244	Compacted Cohesive Layer
02245	Geosynthetic Clay Layer
02247	General Earth fill
02270	Erosion and Sediment Control
02271	Drainage Control Systems
02272	Gabions
02395	Soil-Bentonite Slurry Trench Cutoff Wall
02397	Bio-Polymer Slurry Drainage Trench Construction Groundwater Collector Trench
02406	FML Geomembrane
02415	Geotextile
02418	Geocomposite (Geotextile/Geonet)
02433	Passive Gas Vents

Division 02 - Cont.

02434	Gas Monitoring Probes
02511	Crushed Stone Paving
02605	Manholes and Inlets
02732	Force Main Systems
02750	Decontamination Pad
02831	Chainlink Fences and Gates
02930	Topsoil and Seeding
02984	Restoration

Division 03

03200	Concrete Reinforcement
03300	Cast-in-Place Concrete
03604	Nonshrink Grout

Division 11

11309	Vertical Pumps
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Division 13

13621	Sampling Equipment
13623	Flowmeter (Magnetic)

Division 15

15078	Polyvinyl Chloride (PVC) Pipe
15079	High Density Polyethylene (HDPE) Pipe
15103	Butterfly Valves
15111	Check Valves
15122	Air Relief Valve

Division 16

16050	Basic Electrical Materials and Methods
16401	Electric Service
16743	Telephone Service
16744	Utility Pole
16900	Instrumentation and Controls
16910	Main Instrument Panel
16930	Instrument and Control Panel Construction
16935	Telephone Automatic Dialer System

SECTION 01010
SUMMARY OF WORK

PART 1 GENERAL

1.01 PROJECT DESCRIPTION

- A. Work of this Contract comprises general construction of a groundwater extraction system comprised of three interceptor trenches, one cut-off wall and a force main and sanitary sewer tie-in. The work is also comprised of the minor regrading of a landfill cover and construction of a cap consisting of a gas vent layer, a flexible membrane, a drainage blanket and vegetative cover. Included with the cap construction is the construction of ancillary drainage berms and structures.

1.02 GROUNDWATER INTERCEPTOR TRENCH SUMMARY

- A. Groundwater interceptor trench system construction requirements are as follows:

1. Prepare work zone to enable trenching operation by relocating existing fencing, constructing diversion berm, clearing and grubbing, and grading surface area.
2. Install creek bank rip-rap and restore fencing.
3. Construct interceptor trench using slurry construction method.
 - install extraction wells in interceptor trench.
 - install observation wells in interceptor trench.
4. Construct soil-bentonite cut-off wall using slurry construction method.
5. Install force main piping with manholes and vaults.
6. Connect force main to municipal sanitary sewer manhole.
7. Install electrical and control systems.
8. Restore work zone including final grading, and seeding.
9. Complete systems testing.

- B. Related Specification Sections:

1. Section 02100 - Site Preparation
2. Section 02221 - Trenching, Backfilling, and Compacting
3. Section 02246 - Granular Drainage Material
4. Section 02247 - General Earth Fill
5. Section 02270 - Erosion and Sediment Control
6. Section 02272 - Gabions
7. Section 02395 - Soil-Bentonite Slurry Trench Cutoff Wall
8. Section 02397 - Bio-Polymer Slurry Drainage Trench Construction Groundwater Collector Trench
9. Section 02415 - Geotextile
10. Section 02511 - Crushed Stone Paving
11. Section 02605 - Manholes and Inlets
12. Section 02732 - Force Main Systems
13. Section 02831 - Chainlink Fences and Gates
14. Section 02930 - Topsoil and Seeding
15. Section 02984 - Restoration
16. Section 03200 - Concrete Reinforcement
17. Section 03300 - Cast-in-Place Concrete
18. Section 03604 - Non-Shrink Grout
19. Section 11309 - Vertical Pumps
20. Section 13621 - Sampling Equipment
21. Section 13623 - Flowmeter (Magnetic)
22. Section 15078 - Polyvinyl Chloride (PVC) Pipe

23. Section 15079 - High Density Polyethylene (HDPE) Pipe
24. Section 15103 - Butterfly Valves
25. Section 15111 - Check Valves
26. Section 15122 - Air Relief Valve
27. Section 16050 - Basic Electrical Materials and Methods
28. Section 16401 - Electric Service
29. Section 16743 - Telephone Service
30. Section 16744 - Utility Pole
31. Section 16900 - Instrumentation and Controls
32. Section 16910 - Main Instrument Panel
33. Section 16930 - Instrument and Control Panel Construction
34. Section 16935 - Telephone Automatic Dialer System

1.03 LANDFILL CLOSURE SUMMARY

A. Landfill closure construction requirements for the existing landfill are as follows:

1. Prepare existing surface to receive compacted final cover layer.
2. Install landfill gas venting geocomposite layer and vents.
3. Place compacted cohesive soil layer.
4. Place geosynthetic clay layer.
5. Place textured FML geomembrane layer.
6. Place geocomposite drainage layer.
7. Place vegetative cover layer.
8. Construct surface water drainage control features including swales and downslope flumes.
9. Install landfill gas monitoring probes.
10. Seed, fertilize and mulch final cover, borrow areas, and disturbed areas.
11. Excavate, dispose, and restore contaminate soil areas.

B. Related Sections

1. Section 02100 - Site Preparation
2. Section 02224 - Excavating, Backfilling, and Compacting
3. Section 02243 - Landfill Subgrade
4. Section 02244 - Compacted Cohesive Layer
5. Section 02245 - Geosynthetic Clay Layer
6. Section 02247 - General Earth Fill
7. Section 02270 - Erosion and Sediment Control
8. Section 02271 - Drainage Control Structures
9. Section 02272 - Gabions
10. Section 02406 - FML Geomembrane
11. Section 02415 - Geotextile
12. Section 02418 - Geocomposite (Geotextile/Geonet)
13. Section 02433 - Passive Gas Vents
14. Section 02434 - Gas Monitoring Probes
15. Section 02511 - Crushed Stone Paving
16. Section 02750 - Decontamination Pad
17. Section 02930 - Topsoil and Seeding

1.04 DEFINITIONS

A. Term "provide" or "provided" shall mean "furnish and install in-place."

1.05 CONTRACTS

- A. Work may be broken up into individual parcels by OWNER. At time of bid letting, OWNER will allocate applicable specifications and drawings to individual Request for Bids, which will be the basis for individual lump sum contracts.
- B. Work by others paid for by CONTRACTOR:
 - 1. Electric Utility will provide primary services to Project site and provide meters at locations as shown on Drawings.
 - 2. Telephone Utility will extend telephone service to site as shown on Drawings.
 - 3. Obtain costs from each utility and include costs in Bid.
- C. Work by others paid for by OWNER:
 - 1. Construction CQA.
 - 2. Survey Construction Record.

1.06 MILESTONES (WORK SEQUENCE)

- A. Groundwater Interception System shall be substantially complete in the eastern one-third of the interception system before capping of southern landfill slope can begin.

PART 2 PRODUCTS

2.01 INTERCEPTOR TRENCH:

- A. Biodegradable Bio-Polymer
 - 1. Bio-Polymer per Section 02397.
- B. Water
 - 1. pH between 6 and 8.
 - 2. Total dissolved solids < 750 mg/l.
 - 3. Total hardness < 250 mg/l.
- C. Slurry
 - 1. Biodegradable Bio-Polymer per Section 02397.
- D. Additives
 - 1. Admixtures per Section 02397.
- E. Backfill
 - 1. Freely draining granular material per Section 02246 and Section 02397.

F. Geotextile

1. Polypropylene.
2. Tensile Strength: 300 (warp) x 200 (fill).
3. Opening size: No. 70 Standard Sieve.
4. Permeability: 0.05 cm/sec.
5. Refer to Section 02415.

G. Extraction Wells

1. PVC, Schedule 80, 8" diameter.
2. Welding solvents - ASTM D2564.
3. Fittings: ASTM D2467 for Schedule 80.
4. Refer to Section 15078 and drawings.

2.02 CUT-OFF WALL:

A. Slurry

1. Bentonite slurry per Section 02395.

B. Bentonite

1. Pulverized premium grade sodium montmorillonite meeting most current API Standard 13A "API Specifications for Oil-well Drilling - Fluid Materials".

C. Water

1. Fresh water free of deleterious substances that adversely affect the properties of the slurry.

D. Additives

1. Admixtures per Section 02395.

E. Backfill

1. Soil per Section 02246 and Section 02395.

2.03 FORCE MAIN AND SANITARY SEWER TIE-IN SYSTEM

A. Pumps

1. Vertical pumps per Section 11309.

B. Force main Equipment

1. Force main equipment per appropriate specification sections.

C. Manholes and Inlets

1. Concrete manholes and inlets per Section 02605.

D. Flow Measuring Vault

1. Precast concrete as per Section 02605.

E. Pitless Adapter

1. Pitless adapter for subsurface discharge of groundwater.

F. Gravity Pipe

1. Pipe per Section 15079.

2.04 LANDFILL GAS VENTING SYSTEM

A. Polyvinyl Chloride (PVC) Pipe

1. Schedule 80, 4-in. diameter perforated and non-perforated.
2. Perforations - slots per drawing detail.
3. Welding Solvents - ASTM D2564.
4. Fittings: ASTM D2464 or D2467 for Schedule 80.

B. Geocomposite

1. Nonwoven (702) needle punched polyester geotextile.
2. High Density Polyethylene (HDPE) geonet.
3. Heat bond geotextile to geonet.
4. Refer to Section 02418.

2.05 LANDFILL CAPPING SYSTEM

A. General Earth Fill

1. On-site material consisting of clean sandy clayey soil materials.
2. Refer to Section 02247.

B. Compacted Cohesive Layer

1. Permeability: 1×10^{-7} cm/sec or less.
2. Free of tree roots, wood or other decayable material.
3. Grain Size: The maximum percentage by weight of particles larger than 1-inch shall not exceed 2%.
4. Refer to Section 02244.

C. FML Geomembrane

1. Low Density Polyethylene textured geomembrane.
2. Thickness: 40-mil.
3. Refer to Section 02406.

D. Geocomposite - Drainage Layer and Gas Vent Layer

1. High Density Polyethylene (HDPE) geonet.
2. Non-woven (7 oz) needle punched polyester material.
3. Heat bond geotextile to geonet.
4. Refer to Section 02418.

E. Vegetative Layer

1. Clayey soil from on-site borrow areas.
2. Top most layer to be a topsoil material per Section 02930.

F. Seeding

1. Consist of Tall Fescue with perennial ryegrass.
2. Refer to Section 02930.

2.06 SURFACE WATER DRAINAGE SYSTEM

A. Drainage Swales/Berms

1. Trapezoidal and "V" shaped ditches constructed on the final grade sideslopes using earth berms made of vegetative layer soils.

B. Downslope Flumes

1. Riprap and gabions per Sections 02271 and 02272.

C. Erosion Control

1. Excelsior mat and blanket per Section 02271.

2.07 MISCELLANEOUS MATERIALS

A. Gas Monitoring Probes.

1. Schedule 40, 1-in. diameter perforated and non-perforated.
2. Perforation-1/8-in. holes.
3. Joints: Flush thread O-ring.
4. Monitoring probes per Section 02434.

2.08 CONTAMINATED SOIL AREA

A. Clean general fill.

1. Refer to Section 02247.

B. Topsoil and sand.

1. Refer to Section 02930.

PART 3 EXECUTION

3.01 INTERCEPTOR TRENCH

- A. Prepare the area by clearing and grubbing any vegetation, trees, stumps, etc.
- B. Spread general fill and cut slope, as needed, to provide a smooth platform and compact/prooffroll to confirm there is a smooth surface on which trench construction activities can be commenced.
- C. Excavate trench to elevations, lines, grades, and cross-sections as shown on drawings.
- D. Excavate to provide a minimum width trench to the required depth along the centerline of the excavation. Coordinate with OWNER for the disposal of the excavated material on site.

- E. Mix water and biodegradable polymer to obtain bio-polymer slurry and place in trench. Refer to Section 02397 for mixing, placement, quality control, and construction testing detail.
- F. Upon confirmation and acceptance of bio-polymer slurry, proceed with placing the geotextile panels. Refer to Section 02415 for placement, quality control, and construction testing detail.
- G. Upon confirmation and acceptance of geotextile, backfilling shall commence as soon as practical and be continuous to minimize the area of trench supported only by slurry. Refer to Section 02221 for placement, quality control, and construction testing detail.
- H. Upon confirmation and acceptance of the backfilling, the bio-polymer slurry shall be degraded and disposed. Refer to Section 02397 for degradation, quality control, and construction testing detail.
- I. Upon confirmation and acceptance of slurry degradation, the trench shall be covered, backfilled to grade and a layer of geotextile shall be placed over the backfill to separate the backfill from subsequent soil layers. Refer to Section 02397 for treatment process.
- J. Upon confirmation and acceptance of final treatment of top of trench, excavation spoil, unused backfill and water generated during work shall be properly staged for removal or removed from site.

3.02 CUT-OFF WALL

- A. Prepare the area by clearing and grubbing any vegetation, trees, stumps, etc.
- B. Spread general fill and cut slope, as needed, to provide a platform and compact/prooffroll to confirm there is a smooth surface on which trench construction activities can be commenced.
- C. Excavate trench to elevations, lines, grades, and cross-sections on drawings.
- D. Introduce soil bentonite-slurry into trench at the same time trenching is begun. Refer to Section 02395 for mixing, placement, quality control, and construction testing detail.
- E. Upon confirmation and acceptance of trench excavation, remove loose material or cuttings from bottom of the trench.
- F. Upon confirmation and acceptance of trench cleaning, backfill shall be mixed, blended, and placed continuously from beginning of trench, in direction of the excavation, to the end of the trench. Refer to Section 02395 for placement, quality control, and construction testing detail.
- G. Upon completion of backfill placement, the cut-off wall shall be capped according to drawings.
- H. Upon confirmation and acceptance of backfilling and capping, all remaining excavated material and slurry shall be removed and the surface cleaned and leveled as directed by the ENGINEER.

3.03 FORCE MAIN AND SANITARY TIE-IN

- A. Prepare the area by clearing any vegetation, trees, stumps, etc. that would impact excavation.
- B. Tap into BCDES manhole and extend gravity sanitary sewer line to the new manhole.
- C. Excavate trench from the force main inspection manhole on the north side of the interceptor trench to the new sanitary sewer manhole.

- D. Upon confirmation and acceptance of the excavation, install the force main piping and related equipment for tie-in to the sanitary sewer. Refer to Section 02732 for procedure on placement, quality control, and construction testing detail.

3.04 LANDFILL GAS MANAGEMENT SYSTEM

A. Passive Gas Vent

1. Construct venting system by trenching into existing refuse to form a 1 foot deep by 2 foot wide by 6 foot long trench. Dispose of waste on-site in designated waste disposal areas.
2. Install 4-inch-diameter PVC Schedule 80 pipe at locations shown on Drawing 4.8 and as per detail on Drawing 4.14.
3. Fill trench with coarse aggregate material around PVC pipe.
4. Follow procedure presented in Section 02433.

3.05 CAP/COVER SYSTEM

- A. Prepare the area by clearing any vegetation, soft soils, and relocating debris that would impact the cover layer such as exposed refuse, cobbles, etc. Coordinate with OWNER the disposal of these materials on-site.
- B. Spread general fill, as needed, to provide a smooth even surface and compact/proofroll to confirm there is a firm surface to receive the compacted cohesive soil.
- C. Upon confirmation and acceptance of the subbase grade surface by the OWNER, proceed with placing the geocomposite (geonet with 2 layers of geotextile) gas venting layer. Refer to Section 02418 for placement, quality control, and construction testing detail.
- D. Upon confirmation and acceptance of the gas vent layer by the OWNER, proceed with placing the 18-inch thick compacted cohesive layer. Refer to Section 02244 for placement, quality control and construction testing detail.
- E. Upon confirmation and acceptance of compacted cohesive layer by OWNER, proceed with placing the geosynthetic clay layer secondary barrier layer. Refer to Section 02245 for placement, quality control and construction testing detail.
- F. Upon confirmation and acceptance of the geosynthetic clay layer install the 40-mil textured FML geomembrane layer. Refer to Section 02406 for placement, quality control and construction testing detail. Anchor geomembrane as detailed on the construction drawings. Install geomembrane pipe boots around gas vents and monitoring piezometers.
- G. Drainage layer upon confirmation and acceptance of the FML geomembrane layer install the geocomposite drainage layer. Refer to Section 02418 for placement, quality control, and construction testing detail.
- H. Upon confirmation and acceptance of the geocomposite layer, place the 30-inch thick vegetative layer taking care when spreading this material over the geomembrane layer. Refer to Section 02247, 3.02A for procedure on placing materials over the geomembrane. Place the material in 12-inch thick lifts using the low ground pressure dozer.
- I. Upon confirmation and acceptance of the vegetative layer, the CONTRACTOR will arrange for final seeding.

3.06 SURFACE WATER DRAINAGE CONTROL SYSTEM

- A. Upon completion of the vegetative cover layer, construct diversion berms at the locations shown on Drawing 4.7 to form trapezoidal and "V" shaped ditches to collect and direct surface water flow to the down slope flume. Use the same material as the vegetative cover, place and compact the soil to provide a berm as detailed on Drawing 4.13.
- B. Construct downslope flume as detailed on Drawing 4.13 using gabion mats. Refer to Section 02272 for details regarding gabion construction and installation.
- C. Install ditch checks in the finished ditches to provide sediment control. Refer to Section 02271 for sediment and erosion control actions.

3.07 CONTAMINATED SOIL

- A. Excavate soil from areas designate on Drawing 4.4, test to confirm clean conditions as described by Section 02224, 1.03.
- B. Dispose of soil in area shown on Drawing 4.5.
- C. Backfill with clean general fill to original ground surface, refer to Section 02224.
- D. Restore surface condition with vegetative growth, refer to Section 02730.

3.08 FIELD CONTROL

- A. Construction staking - NO STAKES are permitted once the compacted cohesive layer and geomembrane liner are installed. As soon as there is at least 2 ft of vegetative cover soil in-place stakes can be used but are limited to a 6-inch driven depth.

- B. Tolerance:

Compacted Cohesive Soil Layer: 0' to +0.1'

Vegetative cover: 0' to +0.2'

- C. Measurement of Cover Layer Thickness

1. Compacted cohesive soil layer - measured by augering through compacted layer to measure actual compacted thickness. Restore to finish grade using bentonite-clay mix or all bentonite.
2. Vegetative cover: Measured by surveyed elevation at grid location before and after soil placement. Measurement shall consider sideslope influence such that the 30-inch thickness is perpendicular to the sideslope.

* * * END OF SECTION * * *

SECTION 01025
MEASUREMENTS AND PAYMENTS

TO BE COMPLETED WHEN GENERAL CONDITION FORMAT IS IDENTIFIED.

*** END OF SECTION ***

SECTION 01030
ALTERNATE BID ITEMS

(TO BE COMPLETED WITH BID PACKAGE)

PART 1 GENERAL

1.01 SUMMARY

- A. Section identifies each alternate by number and describes basic changes to be incorporated into furnishing of Goods and Special Services only when that alternate is made a part by specific provisions in OWNER/CONTRACTOR Procurement Agreement.
- B. Related Requirements:
 - 1. Procurement Documents: Method of quotation of cost of each alternate, and basis of OWNER'S acceptance of alternates.
- C. Referenced sections of Specifications stipulate pertinent requirements for products and methods to furnish Goods and Special Services stipulated under each alternate.

1.02 DESCRIPTION OF ALTERNATES

- A. Alternate // // to Bid Item // //.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

* * * END OF SECTION * * *

SECTION 01041
PROJECT COORDINATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Project Coordination Procedures.
2. Contractor responsibilities.
3. Closeout responsibilities.

1.02 COORDINATION

A. CONTRACTOR shall:

1. Coordinate Work of own employees and subcontractors.
2. Expedite Work to ensure compliance with schedules.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 CONSTRUCTION ORGANIZATION AND STARTUP

A. CONTRACTOR shall establish on-site lines of authority and communications.

1. Schedule and conduct progress meetings.
2. Establish procedures for intra-Project communications.
 - a. Submittals.
 - b. Reports and records.
 - c. Recommendations.
 - d. Coordination drawings.
 - e. Schedules.
 - f. Resolution of conflicts.
3. Interpret Contract Documents.
 - a. Consult with ENGINEER to obtain interpretation.
 - b. Assist in resolution of questions or conflicts which may arise.
 - c. Forward written interpretations to other concerned parties.
4. Assist in obtaining permits and approvals.
 - a. Building permits and special permits required for Work or temporary facilities.
 - b. Obtain inspections for Work and temporary facilities.

5. Control use of site.

- a. Supervise field engineering and site layout.
- b. Allocate space for field offices, sheds, and Work and storage areas.
- c. Establish access, traffic, and parking allocations and regulations.
- d. Monitor use of site during construction.

3.02 CONTRACTOR CONSTRUCTION DUTIES

A. Construction Schedules:

- 1. Coordinate schedules in accordance with Section 01310.

B. Inspection and Testing:

- 1. Inspect Work to ensure performance in accordance with requirements of Contract Documents.
- 2. Recommend special testing and inspections of suspect Work.
- 3. Coordinate testing laboratory services.
 - a. Verify required laboratory personnel are present.
 - b. Verify tests are made in accordance with specified standards.
 - c. Review test reports for compliance with specified criteria.
 - d. Recommend and administer required retesting.

C. Monitor use of temporary utilities.

- 1. Verify that adequate services are provided and maintained.
- 2. Coordinate use of OWNER'S facilities.

D. Monitor periodic cleaning.

- 1. Enforce compliance with Specifications.
- 2. Resolve conflicts.

E. Implement procedures for review and processing of Subcontractors' applications for progress and final payments.

- 1. Review each application for payment, submit recommendations to ENGINEER.

F. Maintain reports and records at job site, available to ENGINEER and OWNER.

- 1. Daily log of progress of Work.
- 2. Records.
 - a. Contracts.
 - b. Purchase orders.
 - c. Materials and equipment.
- 3. Maintain file of record documents.
- 4. Assemble documentation for handling of claims and disputes.

3.03 CONTRACTOR CLOSEOUT DUTIES

A. Mechanical and Electrical Equipment Startup:

1. Coordinate checkout of utilities, operational systems, and equipment.
2. Assist in initial startup and testing.
3. Record dates of start of operation of systems and equipment.
4. Submit to OWNER written notice of beginning of warranty period for equipment put into service.

B. At completion of Work, conduct inspection ensuring following.

1. Specified cleaning accomplished.
2. Temporary facilities removed from site.

C. Substantial Completion:

1. Conduct inspection confirming or supplementing Contractor's list of Work to be completed or corrected.
2. Assist ENGINEER in inspection.
3. Supervise correction and completion of Work as established in Certificate of Substantial Completion.

D. Final Completion:

1. When each Contractor determines Work is finally complete, conduct inspection to verify completion of Work.
2. Assist ENGINEER in inspection.

E. Administration of Contract Closeout:

1. Receive and review Subcontractor's final submittals.
2. Transmit to OWNER with recommendations for action.
3. Assemble record drawings and forward to ENGINEER.

* * * END OF SECTION * * *

SECTION 01050
CONSTRUCTION STAKING

PART 1 GENERAL

1.01 SUMMARY

- A. Proposed Work will be staked once, by ENGINEER, at no expense to CONTRACTOR. Should CONTRACTOR request restaking, this Work will be done as ENGINEER'S schedule permits and at expense of CONTRACTOR. CONTRACTOR shall notify ENGINEER at least 3 days prior to start of work and when making periodic requests for line and grade stakes.
 - 1. ENGINEER will provide two lines of survey stakes each for the trench/cut-off wall and landfill cap. These lines will consist of three hubs set at 200 ft on center in perpendicular directions.
 - 2. CONTRACTOR shall maintain survey stakes.
- B. Measurements and Payments:
 - 1. Consider Work specified in this section incidental (except items specifically noted as being provided by OWNER) and include cost as part of appropriate unit prices in Bid Form.

1.02 PRIMARY CONTROL MONUMENT

- A. The location of bench marks and movements provided by OWNER to establish primary vertical and horizontal control for Work will be established at pre-construction meeting. Elevations are referenced to MSL datum.
- B. Preserve and maintain primary control monuments.

1.03 PRIMARY LINE AND GRADE

- A. Primary line and grade will be provided by OWNER and established by ENGINEER by means of stakes placed along route or at site of Work.
- B. Stakes for utilities installed by open cut construction will be set:
 - 1. Parallel to centerline of utility at 50-ft intervals.
 - 2. Offset to best serve CONTRACTOR.
 - 3. Adjacent to sewer appurtenances and force main or water main fittings.
 - 4. At changes in grade.
- C. CONTRACTOR shall:
 - 1. Provide assistance as required.
 - 2. Arrange operations to avoid interference with establishment of primary lines and grades.
 - 3. Check accuracy of line and grade by visual inspection, checks between stakes, and periodic checks (with surveying equipment) between primary control monuments and stakes.
 - 4. Notify ENGINEER minimum 3 working days prior to start of construction when making requests for primary line and grade stakes.
 - 5. Be responsible for protection and preservation of stakes. Restaking will be done as ENGINEER'S schedule permits, and at CONTRACTOR'S expense.

1.04 CONSTRUCTION LINE AND GRADE

- A. Contractor shall bear sole responsibility for correct transfer of construction lines and grades from primary line and grade points and for correct alignment and grade of completed Work based on lines and grades shown on Drawings.
- B. Transfer line and grade for open cut construction of utilities from primary line and grade stakes to Work by grade boards, laser beam or other acceptable methods.

1.05 LOT CORNERS AND SURVEY MONUMENTS

- A. Protect lot corners and survey monuments shown on Drawings and marked by ENGINEER existing throughout Project area.
- B. If such marked corners and monuments are damaged by CONTRACTOR, replace by Registered Land Surveyor at CONTRACTOR'S expense.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

* * * END OF SECTION * * *

**SECTION 01155
ON-SITE HEALTH AND SAFETY REQUIREMENTS**

PART 1 GENERAL

1.01 SUMMARY

- A. CONTRACTOR is responsible for safe Work practices, including trenching, sheeting and shoring, scaffolding, materials handling and drilling, safe operation of equipment, and safety of employees and other persons or organizations during progress of Work on-site.
- B. Work at Project site may place CONTRACTOR'S personnel in potentially hazardous situations due to CONTRACTOR'S personnel's exposure to leachate, gases, and other hazardous materials.
- C. Payment:
 - 1. CONTRACTOR will be paid for cost for Work performed in Level C as incidental and include cost as part of appropriate unit prices specified in Bid Form or at Level D in accordance with schedule in Bid Form.

1.02 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. CONTRACTOR shall plan for and ensure personnel comply with basic provisions of OSHA Safety and Health Standards (29 CFR 1910), and General Construction Standards (29 CFR 1926), as applicable to specific tasks.

1.03 OPERATIONS AND EQUIPMENT SAFETY

- A. CONTRACTOR is responsible for initiating, maintaining, and supervising safety precautions and programs in connection with Work. CONTRACTOR shall take necessary precautions for safety of employees on Work and other persons and organizations who may be affected thereby.
- B. Comply with applicable laws and regulations of any public body having jurisdiction for safety of persons or property or to protect them from damage, injury or loss, and erect and maintain necessary safeguards for such safety and protection.
- C. CONTRACTOR'S duties and responsibilities for safety in connection with Work shall continue until such time as Work is complete and ENGINEER has issued notice to CONTRACTOR that Work is acceptable.

1.04 HAZARDOUS MATERIALS HEALTH AND SAFETY

- A. ENGINEER has developed Health and Safety Plan (HASP) for environmental safety of personnel on-site.
- B. HASP is presented as Support Plan C of Project Design Report. CONTRACTOR shall become familiar with HASP and comply with plan's requirements.
- C. Work shall be performed in accordance with Level D personal protection as defined in HASP. Provisions shall be made to upgrade to Level C, if necessary.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

***** END OF SECTION *****

SECTION 01200
PROJECT MEETINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Schedule and administer preconstruction meeting, prework meeting, periodic progress meetings, and specially called meetings throughout progress of work.
 - 1. Prepare agenda for meetings.
 - 2. Distribute written notice of each meeting 4 days in advance of meeting date.
 - 3. Make physical arrangements for meetings.
 - 4. Preside at meetings.
 - 5. Record minutes; include significant proceedings and decisions.
 - 6. Reproduce and distribute copies of minutes within 3 days after each meeting.
 - a. To participants in meeting.
 - b. To parties affected by decisions made at meeting.
 - c. Furnish 2 copies of minutes to OWNER, 1 copy to OWNER'S site representative, and 1 copy to ENGINEER.
- B. Representatives of CONTRACTOR, Subcontractors, and suppliers attending meetings shall be qualified and authorized to act on behalf of entity each represents.

1.02 PRECONSTRUCTION CONFERENCE

- A. Before OWNER issues Notice to Proceed, CONTRACTOR shall meet with OWNER for preconstruction conference.
- B. Purpose of Conference:
 - 1. Review submittals.
 - 2. Safety programs.
 - 3. Payrolls and labor relations.
 - 4. Environmental protection.
 - 5. Progress schedules.
 - 6. Payment and procurement of materials.
 - 7. Review principal features of Work.
 - 8. Address CONTRACTOR'S questions regarding Contract and Work site.
- C. CONTRACTOR shall submit proposed site-specific quality control (QC) plan, including chemical quality control. CONTRACTOR'S QC program and proposed QC plan shall be briefly reviewed to provide OWNER with general understanding of QC system.

1.03 PREWORK CONFERENCE

- A. As soon after Notice to Proceed as practicable, and prior to starting on-site Work, prework conference will be held between CONTRACTOR and OWNER or OWNER'S representative.
- B. Attendance:
 - 1. CONTRACTOR'S superintendent.
 - 2. Quality control supervisor.

3. Safety personnel.
4. Major Subcontractors' job superintendents.

C. Purpose of Conference:

1. Further define quality control system.
 2. Review QC plan.
 3. Develop mutual understanding of specific requirements established by Contract.
- D. Specifics of CONTRACTOR'S health, safety, and emergency plan shall be discussed so emergency procedures and safety requirements are understood by those directly related to site work.
- E. CONTRACTOR'S schedule, particularly for initial startup period, shall be discussed.
- F. Questions concerning administrative requirements outlined during preconstruction conference or any other aspect of Project shall be addressed.

1.04 PROGRESS MEETINGS

- A. CONTRACTOR shall schedule and administer progress meetings at minimum of once per week and such additional meetings as required, or as requested by OWNER.

B. Attendance:

1. OWNER or OWNER'S representative.
2. CONTRACTOR'S superintendent.
3. CONTRACTOR'S quality control supervisory engineer.
4. CONTRACTOR'S safety and emergency coordinator.
5. Subcontractors as appropriate to agenda.
6. Suppliers as appropriate to agenda.

C. General Meeting Requirements:

1. CONTRACTOR shall administer following general requirements for progress meetings.
 - a. Prepare agenda for meetings.
 - b. Make physical arrangements for meetings.
 - c. Preside at meetings.
 - d. Record significant proceedings and decisions of meeting.
 - e. Reproduce and distribute copies of meeting record within 3 days after each meeting to participants in meeting and to parties affected by decisions made at meeting. Furnish 2 copies of minutes to OWNER, 1 copy to OWNER'S site representative, and 1 copy to ENGINEER.

D. Suggested Agenda:

1. Review and approval of record of previous meeting.
2. Review of Work progress since previous meeting.
3. Field observations, problems, and conflicts.
4. Problems impeding Work schedule.
5. Review of off-site delivery schedules.
6. Corrective measures and procedures to regain projected schedule.
7. Revisions to Project schedule.
8. Planned progress during Work period.
9. Coordination of schedules.

10. Review submittal schedules; expedite as required.
11. Maintenance of quality and safety standards.
12. Pending changes and substitutions.
13. Review proposed changes for effect on construction schedule and completion date, and on other contracts of Project.
14. Other business.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

***** END OF SECTION *****

**SECTION 01310
CONSTRUCTION PROGRESS SCHEDULES**

PART 1 GENERAL

1.01 SUMMARY

- A. Within 10 days after Effective Date of Agreement, prepare and submit to ENGINEER for review estimated Construction Progress Schedule.
- B. No Work shall be performed between 6:00 p.m. and 7:00 a.m., nor on Saturday's, Sundays or legal holidays without written permission of OWNER. Emergency work may be performed without prior permission.
- C. Night work may be established by CONTRACTOR as regular procedure with written permission of OWNER. Such permission may be revoked at any time by OWNER if CONTRACTOR fails to maintain adequate equipment and supervision for proper execution and control of Work at night.

1.02 FORM OF SCHEDULE

- A. Prepare schedule in form of horizontal bar chart.
 - 1. Provide separate horizontal bar for each trade, activity or operation.
 - 2. Provide continuous vertical line to identify first working day of each week.
 - 3. Scale and space to allow for notations and future revisions.
- B. Format of Listings: Chronological order of start of each activity or operation.

1.03 CONTENT OF SCHEDULE

- A. Construction Progress Schedule:
 - 1. Show complete sequence of construction by activity or operation.
 - 2. Coordinate Construction Progress Schedule with Submittals.
 - 3. Show dates for beginning and completion of each activity or operation during construction and installation dates for major items of equipment. Activities and operations shall include, but not be limited to following.
 - a. Material and equipment order, manufacturer, delivery, installation, and checkout, including allowance items.
 - b. Performance tests and supervisory services activity.
 - c. Piping and wiring installation.
 - d. Construction of various facilities.
 - e. Backfilling, grading, seeding, sodding, landscaping, fence construction, and paving.
 - f. Electrical work activity.
 - g. Plumbing work activity.
 - h. Sewer installation.
 - i. Equipment installation.
 - j. Connection to existing sewers.
 - k. Subcontractor's items of Work.
 - l. Allowance for inclement weather.
 - m. Demolition.
 - n. Miscellaneous concrete placement.
 - o. System startup.

- p. Final cleanup.
- q. O&M data submittal.

4. Show projected percentage of completion for each item as of first day of each month.

1.04 SCHEDULE REVISIONS

- A. Every 30 days, revise Construction Progress Schedule to reflect changes in progress of Work.
- B. Indicate progress of each activity or operation at date of schedule revision.
- C. Show changes occurring since previous revised submittal.
 - 1. Major changes in scope.
 - 2. Activities modified since previous submittal.
 - 3. Revised projections of progress and completion.
 - 4. Other identifiable changes.
- D. Every 7 days, provide narrative report defining following.
 - 1. Problem areas, anticipated delays, and impact on schedule.
 - 2. Corrective action recommended and its effect.
 - 3. Effect of changes on schedules of other Contractors.
- E. Submit to ENGINEER.

1.05 DELAYS AND RECOVERY

- A. If, at any time during Project, CONTRACTOR fails to complete activity by its latest scheduled completion date, CONTRACTOR shall, within 3 working days, submit to ENGINEER written statement as to how and when Work force will be reorganized to return Contract to current construction schedule.
- B. When it becomes apparent from progress evaluation and updated schedule data that milestone completion or Contract completion dates will not be met, CONTRACTOR shall take some or all of following actions.
 - 1. Increase construction staffing in such quantities and crafts as shall substantially eliminate backlog of Work.
 - 2. Increase number of working hours per shift, shifts per Work day, Work days per week, or amount of construction equipment, or combination of foregoing sufficient to substantially eliminate backlog of Work.
 - 3. Reschedule Work items to achieve concurrency of accomplishment.
- C. Addition of equipment or construction forces, increasing working hours or other method, manner or procedure to return to current Construction Progress Schedule will not be considered justification for amending Contract Documents or treated as acceleration.

1.06 SUBMITTAL REQUIREMENTS

- A. For initial submittal of Construction Progress Schedule and subsequent revisions thereof, submit 6 copies of schedule to ENGINEER. Failure to submit schedule on timely basis as previously noted shall be considered cause for withholding progress payments otherwise due under this Contract.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

* * * END OF SECTION * * *

SECTION 01340
SUBMITTALS

PART 1 GENERAL

1.01 SUMMARY

- A. This section identifies and references major Contract submittals and is provided for CONTRACTOR information. Omission from this list of submittals as specified elsewhere in these Contract Documents, or as required by local, state or federal regulations does not relieve CONTRACTOR from making such submittals at no additional cost to OWNER.
- B. CONTRACTOR'S attention is directed to individual Specification sections in these Contract Documents which contain additional and special submittal requirements.

1.02 SUBMITTALS

A. Following Award:

- 1. Notice to Office of Federal Contract Compliance.

B. Pre-Notice to Proceed:

- 1. Key employee approval.
- 2. Certificate of Insurance.
- 3. Site Preparation and Maintenance Plan.
- 4. CONTRACTOR Quality Control Plan.
- 5. Initial schedule.
- 6. Site Security Plan.
- 7. Disposal facility letters of agreement.
- 8. Decontamination facility details.

C. Prior to Work on Site:

- 1. Hazardous Environment Protection Program.
- 2. Health and Safety Plan.
- 3. Medical certification.
- 4. H/S staff names and experience.
- 5. Certification of training and course outline.
- 6. CONTRACTOR'S Material Handling Plan.

D. Routine:

- 1. Field notes and measurements.
- 2. Daily quality control reports.
- 3. Progress meeting agenda and records.
- 4. Schedule updates.
- 5. Project photographs.
- 6. H/S logs and reports.

E. Other:

- 1. Revisions to approved plans/schedules.
- 2. Deviations from Contract Documents.

3. Certificates of compliance.
4. Record documents.
5. Certifications of decontamination.
6. CONTRACTOR quality control revisions.
7. Spill notifications and cleanup plans.
8. Utility release information.
9. Visitor release forms.

1.03 SUBMITTAL REQUIREMENTS

- A. Submit required by Contract Documents to ENGINEER.
- B. Submit 6 copies.
- C. Submittals shall contain following.

1. Date of submittal and dates of previous submittals.
2. Project title and number.
3. Contract identification.
4. Name of CONTRACTOR.
5. Field dimensions, clearly identified.
6. Relation to adjacent or critical features of work or materials.
7. Applicable standards, such as ASTM or Federal Specification numbers.
8. Identification of deviations from Contract Documents.
9. Identification of revisions on resubmittals.
10. 8-in. by 3-in. blank space for CONTRACTOR and ENGINEER stamps.
11. CONTRACTOR'S stamp, signed, certifying review of submittal, verification of products, field measurement, field construction criteria, and coordination of information within submittal with requirements of Work and Contract Documents.

1.04 RESUBMITTAL REQUIREMENTS

- A. Make corrections or changes in submittals required by ENGINEER and resubmit until approved.

1.05 ENGINEER'S DUTIES

- A. Review submittals with reasonable promptness and in accordance with schedule.
- B. Affix stamp and signature, and indicate requirements for resubmittal or approval of submittal.
- C. Return submittals to CONTRACTOR for distribution or for resubmittal.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

* * * END OF SECTION * * *

**SECTION 01370
SCHEDULE OF VALUES**

PART 1 GENERAL

1.01 SUMMARY

- A. Submit Schedule of Values allocated to various portions of Work as required by General Conditions.
- B. Upon request of ENGINEER, support values with data substantiating their correctness.

1.02 FORM AND CONTENT OF SCHEDULE OF VALUES

- A. Type schedule on 8-1/2-in. by 11-in. white paper; CONTRACTOR'S standard forms and automated printout will be considered for approval by ENGINEER upon CONTRACTOR'S request. Identify schedule with following.
 - 1. Project title and location.
 - 2. ENGINEER and ENGINEER'S Project number.
 - 3. Name and address of CONTRACTOR.
 - 4. Contract designation.
 - 5. Date of submission.
- B. Identify installed value of component parts of Work in sufficient detail to serve as basis for computing values for progress payments during construction.
- C. Provide separate listing of items of General Requirements (Division 1), such as bonds, insurance premiums, job mobilization, field supervision and layout, construction facilities and temporary controls, contingency allowance, construction schedule, O&M data, record drawings, and submittals.
- D. Follow table of contents of this Project Manual as format for listing component items.
 - 1. Identify each line item with number and title of respective Specification division and section.
- E. For each Specification division, list subvalues of major materials, equipment or operations under division.
- F. For Various Portions of Work:
 - 1. Each item shall include directly proportional amount of CONTRACTOR'S overhead and profit.
 - 2. For items on which progress payments will be requested for stored materials, break down value into:
 - a. Cost of materials, delivered and unloaded, with taxes paid.
 - b. Total installed value including CONTRACTOR'S overhead and profit.
- G. Sum of values listed in schedule shall equal total Contract sum.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

* * * END OF SECTION * * *

SECTION 01380
CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.01 SUMMARY

- A. CONTRACTOR shall take construction record photographs periodically during course of Work.

1.02 PHOTOGRAPHY REQUIRED

A. Prework Photographs:

1. Use wide angle lens and take views of general site showing location and arrangement of C&DD and access roads.
2. Using standard lens, take sufficient photographs to show minimum of 2 views of each area to be impacted by construction.

B. Progress Photographs:

1. After Work started at site, photographically record progress of Work. Include coverage of following.
 - a. Trench/wall construction.
 - b. Cap construction.
 - c. Unanticipated events such as spillage or other accidents.
 - d. Decontamination of equipment and transport vehicles.
 - e. Personnel decontamination facilities.
 - f. Site or task specific employee respiratory and personnel inspection.
 - g. Vehicle and equipment decontamination facility.
 - h. In-situ soil treatment.
2. Photographs shall illustrate conditions and location of Work and state of progress. Consult with Site Coordinator/Administrator at each period of photography for recommendations concerning views required.
3. Actual number and location of views to be taken for progress photographs shall be as directed by Project Manager.

C. Post-Work Photographs:

1. After completion of Work, CONTRACTOR shall take sufficient views of general site to record post-work condition using wide angle lens.

D. Negatives:

1. Remain property of photographer.
2. Maintain negatives for period of 2 yrs from date of Substantial Completion of entire Project.
3. Furnish additional prints to Project Manager and ENGINEER at commercial rates applicable at time of purchase.

- E. CONTRACTOR shall notify ENGINEER at least 5 days prior to taking construction photographs listed above.

1.03 COSTS OF PHOTOGRAPHY

A. Pay costs for specified photography and prints.

1. Parties requiring additional photography or prints shall pay photographer directly.

PART 2 PRODUCTS

2.01 PRINTS

A. Color:

1. Paper: Commercial quality, single weight, white base.
2. Finish: Smooth surface, glossy.
3. Size:
 - a. Prewrite, Post Work: 8-in. by 10-in.
 - b. Progress: 3-in. by 5-in.

B. Identify Each Print:

1. Each print shall show, by photographic means, information box, 1-1/2 in. by 3-1/2 in. in lower right hand corner. Information box for 3-in. by 5-in. photographs shall be scaled down accordingly, or taped to bottom of photograph.
2. Box shall be typewritten and arranged as follows.

EPA Superfund Site:

Skinner Landfill
Butler County, Ohio

Project No: _____ Contract No.: _____

Contractor: _____

Photograph No.: _____ Date: _____

Description: _____

2.02 SLIDES

- #### A.
- Slides shall be color, standard commercial quality, and labeled Butler County, Ohio, dated and numbered sequentially for reference. Slide reference list shall be prepared giving information specified for prints.

PART 3 EXECUTION

3.01 TECHNIQUE

- #### A.
- Factual presentation.

B. Correct exposure and focus.

- 1. High resolution and sharpness.**
- 2. Maximum depth-of-field.**
- 3. Minimum distortion.**

3.02 DELIVERY OF PRINTS

- A. Deliver 3 prints and 3 slides of each photograph, with negatives, within 10 calendar days after taking photographs. Photographs shall be U.S. EPA property and not released by CONTRACTOR to anyone except Site Coordinator/Administrator. Photographs shall be enclosed back-to-back in double-faced plastic sleeve punched to fit standard 3-ring binder.**
- B. Deliver 2 sets of prints to Site Coordinator/Administrator to accompany each Application for Payment.**

*** * * END OF SECTION * * ***

SECTION 01410
TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 PERFORMANCE REQUIREMENTS

- A. OWNER will employ for services of independent testing laboratory to perform testing for work specified in following sections:
 - 1. Section 02221 - Trenching, Backfilling, and Compacting.
 - 2. Section 03300 - Cast-in-Place Concrete.
 - 3. Section 02244 - Compacted Cohesive Layer.
- B. CONTRACTOR shall employ services of independent testing laboratory approved by OWNER to perform other testing as described in Specification.
- C. CONTRACTOR shall cooperate with laboratory provided by OWNER to facilitate execution of laboratories required services.
- D. Employment of laboratory shall, in no way, relieve CONTRACTOR of obligations to perform work.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. E329-90 - Standard Practice for Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

1.03 QUALIFICATION OF LABORATORY

- A. Meet basic requirements of ASTM E329.
- B. Authorized to operate in State of Ohio.
- C. Testing Equipment:
 - 1. Calibrated at reasonable intervals by devices of accuracy traceable to either:
 - a. National Bureau of Standards.
 - b. Accepted values of natural physical constants.

1.04 LABORATORY DUTIES

- A. Cooperate with ENGINEER and CONTRACTOR; provide qualified personnel to perform Work after due Notice to Proceed.
- B. Perform specified inspections, secure samples, and test materials.
 - 1. Comply with specified standards.
 - 2. Ascertain compliance of materials with Contract Documents.
- C. Promptly notify ENGINEER of observed irregularities or deficiencies of Work, equipment or material.

D. Promptly submit written report of each test and inspection; one copy each to ENGINEER, OWNER, material supplier, and CONTRACTOR, and one copy to record document file. Each report shall include following.

1. Date issued.
2. Project title and number.
3. Testing laboratory name, address, and telephone number.
4. Name and signature of laboratory inspector.
5. Date and time of sampling or inspection.
6. Record of temperature and weather conditions if test performed in field.
7. Date of test.
8. Identification of product and Specification section.
9. Location of sample or test in Project.
10. Type of inspection or test.
11. Results of tests and compliance with Contract Documents.
12. Interpretation of test results, when requested by ENGINEER.

E. Perform additional tests as required by ENGINEER.

1.05 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

A. Laboratory is not authorized to:

1. Release, revoke, alter or enlarge on requirements of Contract Documents.
2. Approve or accept any portion of Work.
3. Perform duties of CONTRACTOR.

1.06 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel and provide access to Work.

B. Provide to laboratory preliminary design mix proposed to be used for concrete and other material mixes which require control by testing laboratory.

C. Furnish copies of product test reports.

D. Furnish incidental labor and facilities.

1. Provide access to Work to be tested.
2. Obtain and handle samples at Project site or at source of product to be tested.
3. Facilitate inspections and tests.
4. Store and cure test samples.

E. Notify laboratory and ENGINEER sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.

1. When tests or inspections cannot be performed after such notice, reimburse OWNER for laboratory personnel and travel expenses incurred due to CONTRACTOR'S negligence.

F. Make arrangements with laboratory and pay for additional samples and tests required for CONTRACTOR'S convenience.

G. Employ and pay for services of testing laboratory to perform additional inspections, sampling, and testing required when initial tests indicate Work does not comply with Contract Documents.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

*** * * END OF SECTION * * ***

SECTION 01500
TEMPORARY CONSTRUCTION FACILITIES AND UTILITIES

PART 1 GENERAL

1.01 QUALITY ASSURANCE

- A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).
 - 1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
 - 2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.
- B. Regulatory Requirements:
 - 1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.
- C. Comply with federal, state, and local codes and regulations, and with utility company requirements.

PART 2 PRODUCTS

2.01 TEMPORARY ELECTRICITY AND LIGHTING

- A. General:
 - 1. Temporary lighting shall be sufficient to enable CONTRACTOR and Subcontractors to complete Work and enable ENGINEER to observe Work as it is being performed. Illumination shall meet or exceed state code requirements.
- B. Responsibilities:
 - 1. Provide, maintain, and remove temporary electric service facilities.
 - 2. Facilities exposed to weather shall be weatherproof type and electrical equipment enclosure locked to prevent access by unauthorized personnel.
 - 3. Pay for installation of temporary services including poles, transformer charges.
 - 4. Arrange with local electric utility for temporary electric service subject to their requirements and approval.
 - 5. Register temporary meter in CONTRACTOR'S name.
 - 6. Provide and maintain lamps, wiring, switches, sockets, and similar equipment required for temporary lighting and small power tools.
 - 7. Pay for electrical energy consumed for construction purposes including operation of ventilating equipment for heating of buildings, and for testing and operating of equipment after permanent wiring has been installed, until final acceptance by ENGINEER or until occupancy by OWNER.
 - 8. Provide and pay for service to temporary offices.

2.01 TEMPORARY TELEPHONE SERVICE

- A. Arrange with local telephone company to provide telephone service throughout duration of Work.
- B. Locate telephone in Project construction office for local calls.

2.02 WATER FOR CONSTRUCTION

- A. Water is not available at Project site. Make arrangements and pay costs to obtain suitable water.

2.03 WATER FOR TESTING

- A. CONTRACTOR shall provide water necessary for testing prior to acceptance of Work, unless specifically stated otherwise in Specifications for equipment, system or facility.

2.04 SANITARY FACILITIES

- A. No sanitary facilities are available on site.
- B. Provide temporary sanitary toilet facilities conforming to state and local health and sanitation regulations, in sufficient number for use of ENGINEER'S, CONTRACTOR'S and Subcontractor's employees.
- C. Maintain in sanitary condition and properly supply with toilet paper.

2.05 TEMPORARY FIRE PROTECTION

- A. Provide and maintain in working order, minimum of one fire extinguisher in each construction trailer, and such other fire protective equipment and devices as would be reasonably effective in extinguishing fires during early stages by personnel at Project site.

2.06 TEMPORARY SITE AND OTHER ROADS

- A. Construct and maintain temporary site roadways in snow free, ice free, driveable condition necessary to carry out construction operations.
- B. Maintain OWNER'S existing roads and public roads used during construction free from accumulations of dirt, mud and construction debris resulting from construction operations. Roads shall be considered "maintained" when material has been removed by a sweeper.

2.07 SECURITY

- A. Security will not be provided by OWNER.
- B. CONTRACTOR shall be responsible for loss or injury to persons or property where Work is involved, and shall provide security and take precautionary measures to protect CONTRACTOR'S and OWNER'S interests.

2.08 TEMPORARY PARKING

- A. Designated areas of site may be used for parking of construction personnel's private vehicles and of CONTRACTOR'S light-weight vehicles.
- B. Make arrangements with OWNER.

2.09 PROJECT IDENTIFICATION

- A. Provide signs suitably supported and erected on Project site.
 - 1. Provide one 4-ft by 8-ft sign with names of ENGINEER and CONTRACTOR lettered thereon, in manner approved by ENGINEER.
 - 2. Provide sign no larger than 3 ft by 4 ft, lettered as required by ENGINEER, to identify ENGINEER'S field office.

B. Locate signs where designated by OWNER.

C. Do not place other signs on-site except name of respective Subcontractors on their field offices.

2.10 FIELD OFFICES AND BUILDINGS

A. If required by CONTRACTOR, erect where designated by ENGINEER, and maintain in good condition, temporary field office, tool, and storage building(s) or trailer(s) for CONTRACTOR'S use.

1. Tool storage building(s) or trailer(s) shall be of ample size to provide space for tools and equipment.
2. Building(s) or trailer (s) shall be neat and well constructed, surfaced with plywood, drop siding, masonite, or other similar material, well painted and void of advertisements.

2.11 ENGINEER'S FIELD OFFICE

A. Provide field office with screened windows and lockable doors with minimum floor area of 300 sq ft of which 80 sq ft shall be private office.

1. Provide:
 - a. Heat and air conditioning, capable of maintaining 65°F winter and 75°F summer temperature.
 - b. Electrical power and lights.
 - c. One touchtone telephone with outside bell in private office.
 - d. Potable bottle water with chiller.
 - e. Two desks.
 - f. Two desk chairs.
 - g. One upright, floorstanding drafting table with stool.
 - h. Six holders for 24-in. by 36-in. drawings.
 - i. One 4-drawer, fireproof file cabinet and one standard 4-drawer file cabinet.
 - j. Copy machine capable of copying bound booklets and 11 in. x 17 in. size documents, reduction and multiple page feed capability.
 - k. One portable ABC fire extinguisher.
2. CONTRACTOR is responsible for maintaining utility systems, office equipment, and field office building(s) and for providing expendable supplies for office equipment until final completion.

2.12 OWNER'S USE

A. Upon acceptance of Work, or portion of Work defined and certified as Substantially Completed by ENGINEER, and OWNER commences full-time successful operation of facility or portion thereof, OWNER will pay cost for utilities used for OWNER'S operation. CONTRACTOR shall continue to pay for utilities used until final acceptance of Work, except as provided herein. However, heat for heating building as required for construction purposes shall still be paid by CONTRACTOR unless, due to occupancy by OWNER, more heat shall be required due to increased temperature or lengthened duration, in which case OWNER will bear difference in cost.

PART 3 EXECUTION

3.01 GENERAL

- A. Comply with applicable requirements specified in Divisions 15 and 16.
- B. Maintain and operate systems to ensure continuous service.

- C. Modify and extend systems as Work progress requires.

3.02 REMOVAL AND RESTORATION

- A. Completely remove temporary materials, equipment, signs, and structures when no longer required.
- B. In unfinished areas, clean and repair damage caused by temporary installations or use of temporary facilities, restore drainage, and evenly grade, seed or plant as necessary to provide appearance equal to or better than original.
- C. In finished areas, restore existing or permanent facilities used for temporary services to specified, or original condition.

3.03 DAMAGE TO EXISTING PROPERTY

- A. CONTRACTOR is responsible for replacing or repairing damage to existing buildings, structures, sidewalks, roads, parking lot surfacing, and other existing assets.
- B. CONTRACTOR shall have option of having OWNER contract for such Work and have cost deducted from Contract price.

*** END OF SECTION ***

**SECTION 01560
PROTECTION OF ENVIRONMENT**

PART 1 GENERAL

1.01 SUMMARY

- A. CONTRACTOR, in executing Work, shall maintain Work areas on- and off-site free from environmental pollution that would be in violation of federal, state or local regulations.
- B. Payment:
 - 1. Consider Work specified in this section incidental and include payment as part of appropriate lump sum or unit prices specified in Bid Form.

1.02 PROTECTION OF STORM SEWERS

- A. Observe rules and regulations of State of Ohio and agencies of U.S. government prohibiting pollution of lakes, streams, rivers or wetlands by dumping of refuse, rubbish, dredge material or debris.
- B. Comply with procedures outlined in U.S. EPA manuals entitled, "Guidelines for Erosion and Sedimentation Control Planning and Implementation," Manual EPA-72-015 and "Processes, Procedures, and Methods to Control Pollution Resulting from All Construction Activity," Manual EPA 43019-73-007.

1.03 STORMWATER DISCHARGE

- A. CONTRACTOR shall comply with Ohio Environmental Protection Agency's National Pollution Discharge Elimination System, (NPDES) Storm Water requirements for construction site activities. As a minimum CONTRACTOR is required to prepare, submit, and comply with following.
 - 1. Notice of Intent (NOI).
 - 2. Storm Water Pollution Plan.

1.04 STORMWATER DISCHARGE

- A. CONTRACTOR shall comply with Notice of Intent and Construction Site Erosion Control and Storm Water Management Plan prepared in accordance with Ohio Pollutant Discharge Elimination System OPDES General Permit included with the Contract Documents.
 - 1. ENGINEER will inspect construction site and CONTRACTOR shall make corrections or repairs required.
 - 2. CONTRACTOR shall keep plan on site during the contract time, available for review by WDNR.

1.05 EROSION AND SEDIMENT CONTROL

- A. General guidelines for implementing erosion control measures are included on Drawings.
- B. Apply appropriate soil conservation measures to protect project area and adjacent lands. These measures may include, but not be limited to, mulching, rapid growth vegetation, fabric mat, hay bales, filter barriers, sediment traps, and basins.

- C. Select methods of erosion and sediment control for specific job site.
 - 1. Adjust sediment control measures in field to meet conditions encountered.
 - D. Prepare and submit erosion control plan to ENGINEER. Plan shall include:
 - 1. Limits of disturbance.
 - 2. Types(s) of stabilization to be used.
 - 3. Location of stabilized construction entrance.
 - 4. Location of proposed sediment control measures.
 - 5. Details of sediment traps and basins and other sediment control measures.
 - 6. Sequence of construction as it relates to installation, phasing, and removal of sediment control measures.
 - E. Provide erosion control measures, in place, before commencing work on project site.
 - 1. Maintain erosion control measure during course of construction.
 - 2. Remove erosion control measures upon establishment of permanent, surface stabilization.
 - F. Complete temporary or permanent stabilization of surface of perimeter controls, dikes, swales, ditches, perimeter slopes, and slopes greater than 3:1 within 7 calendar days following initial soil disturbance. Stabilize other disturbed or graded areas within 14 calendar days.
- 1.06 DISPOSAL OF EXCESS EXCAVATED AND OTHER WASTE MATERIALS
- A. Excess excavated material not required or suitable not for backfill and other waste material shall be disposed of on site as directed by Project Manager.
- 1.07 PROTECTION OF AIR QUALITY
- A. Minimize air pollution by requiring use of properly operating combustion emission control devices on construction vehicles and equipment and encourage shutdown of motorized equipment not in use.
 - B. Do not burn trash on construction site.
 - C. If temporary heating devices are necessary for protection of Work, they shall not cause air pollution.
- 1.08 USE OF CHEMICALS
- A. Chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall be approved by U.S. EPA or U.S. Department of Agriculture or any other applicable regulatory agency.
 - B. Use and disposal of chemicals and residues shall comply with manufacturer's instructions.
- 1.09 NOISE CONTROL
- A. Conduct operations to cause least annoyance to residents in vicinity of Work, and comply with applicable local ordinances.
 - B. Equip compressors, hoists, and other apparatus with mechanical devices necessary to minimize noise and dust. Equip compressors with silencers on intake lines.

- C. Equip gasoline or oil-operated equipment with silencers or mufflers on intake and exhaust lines.
- D. Line storage bins and hoppers with material that will deaden sounds.
- E. Conduct operation of dumping rock and of carrying rock away in trucks so as to cause minimum of noise and dust.
- F. Route vehicles carrying rock, concrete or other material over such streets as will cause least annoyance to public and do not operate on public streets between hours of 6:00 p.m. and 7:00 a.m., or on Saturdays, Sundays or legal holidays unless approved by OWNER.

1.10 DUST CONTROL

- A. Due to close geographic location of Project to other off-site facilities and residential homes take special care in providing and maintaining temporary site roadways, OWNER'S existing roads, and public roads used during construction operations in clean, dust free condition.
- B. Comply with local environmental regulations for dust control. If CONTRACTOR'S dust control measures are considered inadequate by ENGINEER, ENGINEER may require CONTRACTOR to take additional dust control measures.

1.11 FUELS AND LUBRICANTS

- A. Comply with local, state and federal regulations concerning transportation and storage of fuels and lubricants.
- B. Fuel storage area and fuel equipment shall be approved by OWNER prior to installation. Submit containment provisions to OWNER for approval.
- C. Report spills or leaks from fueling equipment or construction equipment to OWNER and cleanup as required.
- D. OWNER may require CONTRACTOR to remove damaged or leaking equipment from Project site.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

* * * END OF SECTION * * *

**SECTION 01600
MATERIAL AND EQUIPMENT**

PART 1 GENERAL

1.01 REUSE OF EXISTING MATERIAL

- A. Except as specifically indicated or specified, do not use materials and equipment removed from existing structure(s) in new Work.
- B. For material and equipment specifically indicated or specified to be reused in Work:
 - 1. Use special care in removal, handling, storage, and reinstallation to ensure proper function in completed Work.
 - 2. Arrange and pay for transportation, storage, and handling of products which require off-site storage, restoration or renovation.
 - 3. Off-site storage areas and buildings shall conform to requirements of this section.

1.02 MANUFACTURER'S INSTRUCTIONS

- A. Installation of equipment and materials shall comply with manufacturer's instructions. Obtain and distribute printed copies of such instructions to parties involved in installation, including 2 copies to ENGINEER.
 - 1. Maintain one set of complete instructions at job site during installation and until completion of Work.
- B. Handle, store, install, connect, clean, condition, and adjust materials and equipment in accordance with manufacturer's written instructions and in conformance with Specifications.
 - 1. If job conditions or specified requirements conflict with manufacturer's instructions, consult ENGINEER for further instructions.
 - 2. Do not proceed with Work without written instructions.

1.03 TRANSPORTATION AND HANDLING

- A. Arrange deliveries of materials and equipment in accordance with Construction Progress Schedule, coordinate to avoid conflict with Work and conditions at site.
 - 1. Deliver materials and equipment in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
 - 2. Protect bright machined surfaces, such as shafts and valve faces, with heavy coat of grease prior to shipment.
 - 3. Immediately upon delivery, inspect shipments to ensure compliance with Contract Documents and approved submittals, and products have been protected and are undamaged.
- B. Provide equipment and personnel to handle materials and equipment by methods recommended by manufacturer to prevent soiling or damage to materials or equipment, or packaging.

1.04 STORAGE, PROTECTION, AND MAINTENANCE

- A. On-site temporary storage areas and buildings shall conform to requirements of Section 01500.
- B. OWNER assumes no responsibility for damage or loss due to storage of materials and equipment.

C. Interior Storage:

1. Store with seals and labels intact and legible.
2. Store materials and equipment subject to damage by elements in weathertight enclosures.
3. Maintain temperature and humidity within ranges required by manufacturer's instructions.

D. Exterior Storage:

1. Store fabricated materials and equipment above ground, on blocking or skids, to prevent soiling or staining. Cover materials and equipment subject to deterioration with impervious sheet coverings. Provide ventilation to avoid condensation.
2. Store loose granular materials in well-drained area on solid surfaces to prevent mixing with foreign matter.
3. Store materials such as pipe, reinforcing steel, structural steel, and equipment on pallets or racks, off ground.

E. Inspection and Maintenance:

1. Arrange storage to provide easy access for inspection, maintenance, and inventory.
2. Make periodic inspections of stored materials and equipment to ensure materials and equipment maintained under specified conditions are free from damage or deterioration, and coverings are in-place and in condition to provide required protection.
3. Perform maintenance on stored material and equipment in accordance with manufacturer's written instructions and in presence of OWNER or ENGINEER.
 - a. Notify ENGINEER 24 hrs before performance of maintenance.
 - b. Submit report of completed maintenance and condition of coverings to ENGINEER with each Application for Payment.
 - c. Failure to perform maintenance, to notify ENGINEER of intent to perform maintenance or to submit maintenance report may result in rejection of material or equipment.

F. Assume responsibility for protection of completed construction and repair and restore damage to completed Work equal to original condition.

1.05 SPECIAL TOOLS AND LUBRICATING EQUIPMENT

- A. Furnish, in accordance with manufacturer's recommendations, special tools required for checking, testing, parts replacement, and maintenance. Special tools are those specially designed or adapted for use on parts of equipment, and not customarily and routinely carried by maintenance mechanics.
- B. Deliver to OWNER when unit is placed in operation and after operating personnel have been properly instructed in operation, repair, and maintenance of equipment.
- C. Tools and lubricating equipment shall be of quality compatible to equipment manufacturer has furnished.

1.06 LUBRICATION

- A. Where lubrication is required for proper operation of equipment, incorporate necessary and proper provisions in equipment in accordance with manufacturer's requirements. Where possible, lubrication shall be automated and positive.
- B. Where oil is used, reservoir shall be of sufficient capacity to supply unit for 24-hr period.

PART 2 PRODUCTS

2.01 MATERIALS

A. Material and Equipment Incorporated into Work:

1. Conform to applicable specifications and standards.
2. Comply with size, make, type, and quality specified or as specifically approved by Submittal.

B. Manufactured and Fabricated Materials and Equipment:

1. Design, fabricate, and assemble in accordance with engineering and shop practices standard with industry.
2. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
3. Two or more items of same kind shall be identical, by same manufacturer.
4. Material and equipment shall be suitable for service conditions.
5. Equipment capabilities, sizes, and dimensions shown or specified shall be adhered to, unless variations are specifically approved, in writing, in accordance with General Conditions.
6. Equipment shall be adapted to best economy in power consumption and maintenance. Parts and components shall be proportioned for stresses occurring during continuous or intermittent operation, and for additional stresses occurring during fabrication or installation.
7. Design so working parts readily accessible for inspection and repair, easily duplicated, and replaced.

C. Do not use material or equipment for purpose other than for which it is designed or specified.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL; INSTALLATION, INSTRUCTIONAL, AND POST STARTUP SERVICES

A. General:

1. This article covers on-site services of Supplier's representatives provided by CONTRACTOR during construction, equipment startup, and training of OWNER'S personnel for equipment or plant operation as specifically required in Specification section for equipment or system.
2. Include and pay costs for Supplier's services, including, but not limited to, those specified.
3. Work day is defined as an 8-hour period during a calendar day. Work day for purposes of this section does not include travel to or from the Project site.

B. Installation Services:

1. Where installation services are called for in Specifications, provide competent and experienced technical representatives of manufacturers of equipment and systems to resolve assembly or installation procedures attributable to, or associated with, equipment furnished.
2. After equipment is installed, representatives shall perform initial equipment and system adjustment and calibration to conform to Specifications and manufacturer's requirements and instructions.
3. Provide "Certificate of Installation Services" stating proper adjustments have been made to equipment or system and equipment or system is ready for startup and system demonstration. Furnish 2 copies to ENGINEER.

C. Instructional Services:

1. Where training is called for in Specifications, provide competent and experienced technical representative of Supplier to provide detailed instructions to OWNER'S personnel for operation of equipment. Training services shall include maintenance of instrumentation, maintenance of equipment and operation of instrumentation and equipment in classroom and on-site as stated in Specifications. Training shall include electrical, mechanical, and safety aspects of equipment.
2. Submit documentation identifying name of specific representative, factory authorization, and background of named individual(s) to conduct training. Submit information 30 days before scheduled training period for review and approval by ENGINEER.
3. Coordinate training periods with ENGINEER and supplier's representatives.
 - a. No training shall be conducted unless instructor has been approved by ENGINEER.
 - b. Notify ENGINEER at least 48 hrs before training sessions are to begin so ENGINEER can make arrangements with OWNER'S operating personnel.
 - c. Reschedule canceled training sessions 48 hrs in advance.
 - d. Failure of supplier's or manufacturer's representative to appear for scheduled training, failure to notify ENGINEER 24 hrs in advance of need to cancel scheduled training or failure to arrive within 30 min of start of scheduled training shall result in reimbursement to OWNER for time lost by OWNER'S operating personnel in waiting for arrival of manufacturer's representative. Except in case of failure to arrive on time, time will not exceed 1 hr for each employee scheduled to receive training. Failure to arrive on time will be reimbursed by actual time late up to 1 hr, after 1 hr training will be rescheduled.
4. Similar types of equipment differing in model, size or manufacturer shall require equal service time as stated in specific Specification section.
5. Successful system demonstration required in Section 01670 shall be completed before start of Instructional Services.
6. O&M data shall constitute basis of instruction.
 - a. Review data contents with personnel in full detail to explain aspects of operations and maintenance.
7. Provide "Certificate of Instructional Services," cosigned by OWNER and supplier's representative, verifying training accomplished to satisfaction of all parties. Furnish 2 copies to ENGINEER.

D. Post Startup Services:

1. After equipment/system has been in operation for at least 6 months, but no longer than 11 months, each equipment manufacturer or authorized equipment representative shall make final inspection where so required in Specifications. Final inspection will provide assistance to OWNER'S operating personnel in making adjustments or calibrations required to ensure equipment or system is operating in conformance with design, manufacturer, and Specifications.
2. Provide "Certificate of Post Startup Services," cosigned by OWNER and equipment representative, verifying this service has been performed. Furnish 2 copies to ENGINEER.

* * * END OF SECTION * * *

SECTION 01669
TESTING PIPING SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Detailed requirements for hydrostatic pressure testing of new piping.
- B. All new force main piping systems to be tested as described in this section.

1.02 SUBMITTALS

- A. Test report for each piping system tested. Refer to Attachment 1 to this section.
- B. Submit in accordance with Section 01340.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 GENERAL

- A. Pressure test in presence of ENGINEER.
- B. Furnish water required for testing and provide necessary piping connections between section of piping being tested and nearest available source of water or air supply, together with test pressure equipment, meters, pressure gauge, temperature gauge, and other equipment, materials, and facilities necessary to perform specified tests.
- C. Provide bulkheads, flanges, valves, bracing, blocking or other temporary sectionalizing devices that may be required.
- D. Remove temporary sectionalizing device after tests complete.
- E. Perform tests on piping that is clean and free of dirt, sand or other foreign material.
- F. Plug pipe outlets with test plugs. Brace each plug securely to prevent blowouts.
- G. Add test fluid slowly.
- H. Include regulator set to avoid overpressurizing and damaging piping.
- I. Perform pressure testing in accordance with local, state, and federal requirements.
- J. Cost of testing including water, personnel, equipment, and materials shall be CONTRACTOR'S responsibility.

- K. Correct leaks or defects and retest at no additional cost to OWNER.

3.02 HYDROSTATIC PRESSURE TESTING

- A. Hydrostatic pressure testing: Test pressure shall be at least 150% of design operating procedure, but not less than 50 psi. CONTRACTOR shall verify pipe pressure rating from manufacturer prior to testing to ensure testing pressure is acceptable for pipe.
- B. Open vents at high points to purge air pockets while piping system is filling. Venting may also be provided by loosening flanges or with equipment vents.
- C. Testing:
 - 1. After section of piping to be tested has been filled with water, apply test pressure by means of force pump of such design and capacity that required pressure can be applied and maintained without interruption for duration of test.
 - 2. Measure test pressure by means of tested and properly calibrated pressure gauge acceptable to ENGINEER.
 - 3. Measure temperature by means of a temperature gauge (0° C to 100° C) tapped and threaded into test section.
 - 4. Maintain test pressure for sufficient length of time to permit ENGINEER to observe piping under test but not less than 1 hr.
 - 5. If repairs required, repeat pressure test until pipe installation conforms to specified requirements and is acceptable to ENGINEER.
- D. Piping systems shall show no visual evidence of weeping or leaking.

3.03 TEST REPORT

- A. Prepare and submit test report for each piping system tested. Include following information in test report.
 - 1. Date of test.
 - 2. Description and identification of piping system tested.
 - 3. Type of test performed.
 - 4. Test fluid.
 - 5. Test pressure.
 - 6. Type and location of leaks detected.
 - 7. Corrective action taken to repair leaks.
 - 8. Results of retesting.

**ATTACHMENT 1 TO SECTION 01669
FORM
PE PIPE PRESSURE TEST REPORT**

PROJECT NAME/NO:

TIME:

CONTRACTOR:

DATE:

PERSON PERFORMING TESTS:

DESCRIPTION/LOCATION OF TEST SEGMENT (Pipe Diameter, Length, and SDRs):

T_i = Initial temperature in °C = _____ °C
 P_i = Initial test pressure in psig = _____ psig
 P_c = Initial pressure in psig corrected for temperature (T_i) at time 't'
 t = Time in minutes from initiation of test
 T_t = Temperature in °C at time 't'
 P_t = Test pressure in psig at time 't'
 P_c = $\frac{(P_t + 14.7)(T_i + 273) - 14.7}{(T_t + 273)}$

Percent Pressure Drop = $\frac{P_c - P_t}{P_c} \times 100$

TIME (min.)	P_c TEMP READING (°C)	T_t GAUGE READING (psig)	P_t CORRECTED PRESSURE (psig)	P_c PRESSURE DROP (%)
0				
20				
30				
40				
50				
60				

PASS/FAILURE:

RETEST (yes/no):

DESCRIPTION/NATURE OF LEAKS AND REPAIRS OF RETEST SEGMENT:

EXAMPLE CALCULATION SHEET

GIVEN:

$$P_i = 10 \text{ psig}$$

$$T_i = 21.1^\circ\text{C} = 70^\circ\text{F}$$

and at time $t = 60$ minutes

$$P_t = 10.05 \text{ psig}$$

$$T_t = 23.0^\circ\text{C} = 73^\circ\text{F}$$

Calculated Corrected Initial Pressure

$$P_c = \frac{(10.0 + 14.7)(23.0 + 273)}{(21.1 + 273)} - 14.7$$

$$P_c = 24.85 - 14.7 = 10.15 \text{ psig}$$

Calculate Percent Pressure Loss

$$\% \text{ Pressure Loss} = \frac{10.15 - 10.05}{10.15} \times 100 = 0.98\% < 1\% \text{ ok}$$

NOTE: The difference between the corrected pressure reading (P_c) and the gauge reading (P_t) cannot differ by more than 1% of the corrected pressure reading (P_c) (i.e., 0.105 @ 10.5 psig) over a time interval of 60 minutes.

*** END OF SECTION ***

**SECTION 01670
SYSTEMS DEMONSTRATIONS**

PART 1 GENERAL

1.01 DESCRIPTION

- A.** Before Substantial Completion is considered for entire Work, CONTRACTOR shall test and demonstrate specific items of equipment and systems in operation. Conduct preliminary testing and systems in operation on following systems.

1. System 1 - Groundwater extraction wells

- a.** Extraction wells with pump, power, controls, alarm and associated piping and valves, sanitary sewer -vault and piping.

B. Preliminary:

- 1.** Before CONTRACTOR begins preliminary testing and system operation demonstrations, Installation Services provided for in Section 01600 for each system or equipment shall be completed.

C. Coordination:

- 1.** Designate representative of CONTRACTOR to be responsible for tests and demonstrations of systems.
- 2.** CONTRACTOR shall submit schedule of systems demonstrations for review by ENGINEER and OWNER 30 days prior to system tests and demonstrations.
- 3.** Notify ENGINEER at least 3 working days before tests and system operation demonstrations are to begin so ENGINEER can make arrangements with OWNER to witness testing and demonstration.
- 4.** Reschedule canceled tests and demonstrations of system operations 3 working days in advance.

1.02 SUBMITTALS

A. Operation and Maintenance (O&M) Data:

- 1.** Submit in accordance with Section 01730 before conducting Instructional Services described in Section 01600 where required for each component of system.

B. Reports:

- 1. Preliminary testing of components and systems.**
 - a.** Prepare and submit report within two working days of completion of preliminary tests on activities encompassing preliminary testing of components and systems as required by this section.
 - b.** As minimum, report shall describe findings of inspections; revisions, modifications or replacement of equipment; calibrations; test results; dates and names of persons involved and observing inspections, testing, and other activities pertaining to demonstration of components and systems; and statement regarding operational condition of components and systems.

2. System operation demonstration.

- a. Prepare and submit report within two working days of completion of 120-hr demonstration on activities encompassing system demonstration and operation as required by this section. Report shall describe startup and operational conditions; daily results of systems operation; dates and names of persons involved and observing operation; and statement regarding system ability to meet operational criteria.

C. Submit in accordance with Section 01340.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 PRELIMINARY TESTING OF SYSTEM COMPONENTS

- A. Process, mechanical, instrumentation, and electrical equipment components, including related piping and control systems, shall be subjected to individual inspection and preliminary testing by CONTRACTOR and certified by CONTRACTOR to be ready for process operations before components and systems are put into systems operation demonstration.
- B. Preliminary inspection and tests shall be made to determine if equipment is properly assembled, aligned, adjusted, calibrated, wired or connected. Changes, adjustments or replacements of equipment due to errors or omissions on part of CONTRACTOR, or otherwise necessary to comply with requirements of Contract Documents shall be done without additional cost to OWNER.
- C. Complete training required in Section 01600.

3.02 SYSTEM OPERATION DEMONSTRATION

- A. Upon completion of inspection and preliminary testing of individual components, demonstrate each system of related items of process, mechanical, and electrical equipment and related I&C equipment together for 120 hrs in accordance with requirements of Contract Documents.
 1. Where no specific performance requirements are stated in Specifications, demonstrate to show equipment operates in accordance with acceptable industry standards for application of equipment.
 2. System operation demonstration shall show equipment operates within manufacturer's tolerances for noise and vibration, equipment is responsive to manual and automatic controls, control and protective devices are properly set, and equipment runs on controlled or intermittent basis when such operation is intended.
 3. System operation demonstration shall include checkout from each remote control point. Demonstrate alarm and safety lockout systems for proper function, and process I&C.
- B. During preliminary testing and system operation demonstration, CONTRACTOR shall arrange for presence of qualified representatives of Suppliers of each piece of equipment and instrumentation included in system necessary to conduct test and demonstration.
- C. Supply electrical power, chemicals, fuel and lubricants necessary to operate equipment. Temporary facilities and services are CONTRACTOR'S responsibility. CONTRACTOR shall provide temporary connections if necessary.

- D. Successful operation will be when equipment or system being operated meets performance requirements established in Contract Documents while running for 120 consecutive hrs.
- E. If system is not meeting performance requirements established in Contract Documents during demonstration, CONTRACTOR shall stop demonstration, adjust, calibrate or replace equipment or instrumentation and re-start and run demonstration until 120 consecutive hrs have been completed.

3.03 DETERMINATION OF SUBSTANTIAL COMPLETION

- A. Substantial completion of systems required to be placed in operation prior to substantial completion of Work.
 - 1. Upon successful completion of preliminary testing of system components, system operation demonstrations, and delivery of submittals specified in this section, CONTRACTOR shall notify OWNER and ENGINEER in writing that components and system are substantially complete.
 - 2. Provisions of the General Conditions will apply with respect to procedure for determining substantial completion of that part of Work, certification of Substantial Completion, and division of responsibility in respect thereof and access thereto.
 - 3. Retainage will not be reduced at substantial completion of components and system.
 - 4. Substantial completion will not entitle CONTRACTOR reduction or elimination of liquidated damages.
- B. Other Systems:
 - 1. Other identified systems will be considered for substantial completion when CONTRACTOR considers Work ready for its intended use.
 - 2. Components and systems will be substantially complete after successful completion of preliminary testing of components and systems, system operation demonstration, and delivery of submittals.

* * * END OF SECTION * * *

**SECTION 01720
PROJECT RECORD DOCUMENTS**

PART 1 GENERAL

1.01 SUMMARY

A. Maintain at site one record copy of:

1. Drawings.
2. Project Manual.
3. Addenda.
4. Change orders and other modifications to Contract.
5. ENGINEER field orders, written instructions, or clarifications.
6. Approved submittals.
7. Field test records.
8. Construction photographs.
9. Associated permits.
10. Certificates of inspection and approvals.

1.02 SUBMITTALS

A. At Substantial Completion:

1. Deliver one marked up set of record documents to OWNER.

B. Accompany submittals with transmittal letter containing following.

1. Date.
2. Project title and number.
3. CONTRACTOR'S name and address.
4. Title of record document.
5. Signature of CONTRACTOR or authorized representative.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Store documents and samples on-site apart from documents used for construction.

1. Provide files and racks for storage of documents.
2. Provide secure storage space for storage of samples.

B. Maintain documents in clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

C. Make documents and samples available for inspection by ENGINEER or OWNER.

- D. Failure to properly maintain record documents may be reason to delay a portion of progress payments until records comply with Contract Documents.

3.02 RECORD DOCUMENTS

- A. Label each document "PROJECT RECORD" in neat, large printed letters.
- B. Maintain record set of Drawings and Specifications legibly annotated to show all changes are made during construction.
 - 1. Graphically depict changes by modifying or adding to plans, details, sections, elevations, or schedules.
 - 2. Make changes on each sheet affected by changes.
- C. Record information concurrently with construction progress.
 - 1. Do not conceal Work until required information is recorded.
 - 2. Record changes made by Change Order, Construction Change Directive or order for minor change in Work.
- D. Drawings:
 - 1. General:
 - a. Depths of various elements of foundation in relation to finish first floor datum.
 - b. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - c. Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.
 - d. Field changes.
 - e. Details not on original Drawings.
 - f. Location and identification of exposed interior piping, including those shown schematically on Drawings.
 - g. Size of equipment and location including connections.
 - 2. Specifications:
 - a. Mark Specification sections: to show substantial variations in actual Work performed in comparison with test of Specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation.
 - b. Note related record drawing information and Product Data.
 - 3. Electrical and Instrumentation:
 - a. Horizontal and vertical locations and size of underground cable, conduit, and duct runs dimensioned from established building lines.
 - b. Plan location and size of interior concealed and exposed feeders.
 - c. Size and location of access panels.
 - d. Departures from original Drawings and electrical work revisions.

* * * END OF SECTION * * *

SECTION 01730
OPERATION AND MAINTENANCE (O&M) DATA

PART 1 GENERAL

1.01 SUMMARY

- A. Compile equipment and product data and related information appropriate for OWNER'S operation and maintenance (O&M) for each item of equipment or product as specified in other sections of Specifications.

1.02 QUALITY ASSURANCE

- A. Preparation of data shall be performed by personnel:
1. Trained and experienced in O&M of described products.
 2. Familiar with requirements of this section.
 3. Skilled as technical writer to extent required to communicate essential data.
 4. Skilled as drafter competent to prepare required drawings.

1.03 FORM OF SUBMITTALS

- A. Prepare data in form for use by OWNER'S personnel.
- B. Format: Subject to approval by ENGINEER.

1. Size: 8-1/2 in. by 11 in., or 11 in. by 17 in. folded, with standard 3-hole punching.
2. Paper: 20-lb minimum, white, for typed pages.
3. Text: Manufacturer's printed data, or neatly typewritten.
4. Drawings:
 - a. Bind in with text.
 - b. Fold larger drawings and place in text page size envelopes bound into binder. Place identification on outside of each envelope.
5. Provide tabbed section dividers between each major section.
 - a. Provide title of section on each divider.
 - b. Provide tab index in Table of Contents.
6. Cover Label: Label each submittal cover with typed or printed title "OPERATION AND MAINTENANCE INSTRUCTIONS" and following.
 - a. Project title.
 - b. Name(s) of applicable building(s) or structure(s) as shown on Drawings in which equipment located.
 - c. Name of equipment as set forth in Contract Documents.
 - d. Specification section number for equipment as set forth in Contract Documents.
7. Binders:
 - a. Bind each submittal into commercial quality binder with durable and cleanable plastic covers. Paperboard, laminated paperboard, and canvas covers not acceptable.
 - b. Are to be filled not more than 75% of capacity.

- c. When multiple binders used, contents shall be organized into related groupings and each binder cover shall bear identification of specific content.

1.04 GENERAL CONTENTS OF DATA

- A. Each submittal shall contain equipment data pertaining to not more than one Specification section number indicated in Contract Documents.
- B. Title Sheet: First page in data listing following.
 - 1. Title: "OPERATION AND MAINTENANCE INSTRUCTIONS."
 - 2. Title of Project: "SKINNER LANDFILL."
 - 3. Name(s) structure(s) as shown on Drawings in which equipment is located.
 - 4. Name of equipment as set forth in Contract Documents.
 - 5. Specification section number for equipment as indicated in Contract Documents.
 - 6. CONTRACTOR'S name, address, and telephone number.
 - 7. Subcontractor's name, address, and telephone number if equipment provided by Subcontractor.
 - 8. CONTRACTOR'S or Subcontractor's purchase order number, manufacturer's shop order number or other such numbers required for parts and service ordering.
 - 9. Manufacturer's name, address, and telephone number.
 - 10. Name, address, and telephone number for local source of supply for parts and service.
- C. Product List: Immediately after title sheet containing following.
 - 1. List of each product and major components, indexed to content of submittal, and identified by product name and model number as set forth by manufacturer and specification section and article number.
- D. Table of Contents: Immediately following product list. Arrange in logical, systematic order and shall be at minimum a tab index. Provide each tabbed section with table of contents for section, arranged in systematic order.
- E. Product Data Sheets: Provide specification and catalog sheets showing configuration, manufacturer's specifications, models, options, and styles of equipment and major components being provided. Product data sheets will show project specific information with inapplicable information deleted by removal. Insert in tabbed section(s).
- F. Text:
 - 1. Include only those sheets pertinent to specific project.
 - 2. Each sheet shall:
 - a. Identify specific product or part installed.
 - b. Identify text applicable to product or part installed.
 - c. Contain no inapplicable information.
- G. Drawings:
 - 1. Supplement text with drawings to clearly illustrate following.
 - a. Product and components.
 - b. Relations of component parts of equipment and systems.
 - c. Control and flow diagrams.
 - 2. Drawings to be actual drawings of equipment from manufacturer. "Typical" drawings not acceptable, unless they accurately illustrate actual installation.

H. Specially written information, as required to supplement text for particular installation.

1. Provide explanation of interrelationships of equipment and components, and effects one component has on another or entire system.
2. Provide overall instructions and procedures for equipment tying in instructions and procedures for separate components into unified instructional package.
3. Provide glossary of special terms used by manufacturer.
4. Organize in consistent format under separate headings for different procedures.
5. Provide logical sequence of instructions for each procedure.

I. Copy of each warranty, bond or service contract issued.

1. Provide information sheet for OWNER'S personnel to explain following.
 - a. Proper procedures in event of failure or malfunction to prevent voiding warranty.
 - b. Instances affecting validity of warranties or bonds.

1.05 SPECIFIC CONTENT OF DATA FOR EQUIPMENT AND SYSTEMS

A. Specific content, for each unit of equipment and system, shall include following.

1. Description of Unit and Component Parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, and tests as applicable.
 - c. Complete nomenclature and commercial number of replaceable parts.
 - d. Complete nameplate data.
 - e. P&ID numbers for equipment as set forth in Drawings.
2. Operating Procedures:
 - a. Startup, break-in, and normal operating instructions.
 - b. Regulation, control, stopping, shutdown, and emergency instructions.
 - c. Summer and winter operating instructions, as applicable.
 - d. Special operating instructions.
3. Maintenance Procedures:
 - a. Routine maintenance operations.
 - b. Guide to troubleshooting.
 - c. Disassembly, repair, and reassembly instructions.
 - d. Alignment, adjusting, and checking instructions.
4. Servicing and Lubrication Schedule:
 - a. List of lubricants required and quantity to be applied.
 - b. Schedule of lubrication.
 - c. Schedule for other routine maintenance.
5. Manufacturer's printed instructions regarding safety precautions for both (a) protection of personnel operating the equipment and systems and (b) prevention of damage to the equipment and systems.
6. Description of sequence of operation of controls.

7. Original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 - a. Predicted life of parts subject to wear.
 - b. Items recommended to be stocked as spare parts and quantities of same.
 8. As-approved control diagrams. These shall be ladder diagrams, instrumentation loop diagrams, and electrical schematics as appropriate.
 9. Bill of material.
 10. Completed Equipment Data Form typewritten on copy of Form 1 to Section 01730. Example of completed form is Form 2 of Section 01730.
 11. Other data as required under pertinent sections of Specifications.
- B. Specific content for each electric and electronic system, as applicable to equipment such as switchgear, motor control centers, panelboards, switchboards, starters, breakers, and relays shall include following.
1. Description of System and Component Parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, rating tables, and tests as applicable.
 - c. Complete nomenclature and commercial number of replaceable parts.
 - d. Complete nameplate data.
 - e. P&ID numbers for equipment as set forth on Drawings.
 2. Circuit Directories of Panelboards:
 - a. Electrical service.
 - b. Controls.
 - c. Communications.
 3. Complete instrumentation loop diagrams with tabulated listing of components in each control circuit or loop.
 4. Operating Procedures:
 - a. Routine and normal operating instructions.
 - b. Sequences required.
 - c. Special operating instructions.
 5. Maintenance Procedures:
 - a. Routine maintenance operations.
 - b. Guide to troubleshooting.
 - c. Disassembly, repair, and reassembly instructions.
 - d. Adjustment and checking instructions.
 6. Manufacturer's printed instructions regarding safety precautions for both (a) protection of personnel operating the equipment and systems and (b) prevention of damage to the equipment and systems.
 7. List of original manufacturer's spare parts and recommended quantities maintained in storage.
 8. Other data as required under pertinent sections of Specifications.

1.06 SUBMITTAL SCHEDULE

- A. Submit 4 copies of complete O&M data, bound in covers bearing suitable identification, for review within 30 days after time CONTRACTOR receives approved Shop Drawings for equipment from ENGINEER.
- B. ENGINEER'S review and acceptance of O&M data will be only for conformance with requirements of this section, for form of submittal and organization of data and completeness of information provided, but not for technical content or coordination between individual suppliers of equipment or system(s).
- C. Review O&M submittal and complete Form 3, Contractor Submittal Form, attached to this section in its entirety indicating requirements of this section have been met before submitting to ENGINEER. ENGINEER will reject submittals without completed Form 3. Page number submittals.
- D. ENGINEER will be sole judge of completeness of data.
- E. Payments:
 - 1. Progress payment for equipment delivered, stored or installed under these Contract Documents will not be made until copies of O&M data delivered to and approved by ENGINEER.
 - 2. Progress payments for control systems packaged with equipment will not be made until O&M data incorporated into equipment and control system manual delivered to and approved by ENGINEER.

1.07 INSTRUCTION OF OWNER'S PERSONNEL

- A. Contractor to provide "Walk Thru" of system for Owner's personnel.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

**FORM 1 TO SECTION 01730
EQUIPMENT DATA FORM**

Page 1 of 4

PROJECT NAME			
CONTRACT NO.			
CONTRACTOR			
EQUIPMENT NO.		ASSET NO.*	
DESCRIPTION		MAINT. NO.*	
LOCATION			
MANUFACTURER			
PURCHASED FROM			
VENDOR ORDER NO.		PURCHASE \$	
DATE OF PURCHASE			
LOCAL SUPPLIER			
ADDRESS			
PHONE NO.			
MODEL NO.			
NO. OF UNITS		SERIAL NOS.	
*By Owner			

**FORM 1 TO SECTION 01730
EQUIPMENT DATA FORM**

Page 2 of 4

NAMEPLATE DATA

ELECTRIC MOTOR		PUMP/HVAC UNIT	
MANUFACTURER		MANUFACTURER	
TYPE	[] AC [] DC	TYPE	
HORSEPOWER		SIZE	
RPM		CAPACITY	
VOLTAGE		PRESSURE	
AMPERAGE		ROTATION	
PHASE		IMPELLER SIZE	
FRAME		IMPELLER MATERIAL	
DRIVE/REDUCER		OTHER (I&C)	
MANUFACTURER		MANUFACTURER	
TYPE	<input type="checkbox"/> GEAR <input type="checkbox"/> V-BELT <input type="checkbox"/> CHAIN <input type="checkbox"/> VARIDRIVE	TYPE	
		SIZE	
SERVICE FACTOR		CAPACITY	
RATIO		RANGE	

Page 3 of 4

EQUIPMENT NO.		ASSET NO.*	
DESCRIPTION		MAINT. NO.*	

FREQUENCY:

List required frequency of each maintenance operation.

*By Owner

**FORM 1 TO SECTION 01730
EQUIPMENT DATA FORM**

Page 4 of 4

LUBRICANT/RECOMMENDED SPARE PARTS LIST

EQUIPMENT NO.		ASSET NO.*	
DESCRIPTION		MAINT. NO.*	

LUBRICANT LIST

REFERENCE SYMBOL	LUBRICANT TYPE (MILITARY STANDARD)	RECOMMENDED LUBRICANT AND MANUFACTURER
List symbols in "maintenance operation" (Page 3).	List general lubricant type.	List specific lubricant name, viscosity, and manufacturer.

RECOMMENDED SPARE PARTS LIST

PART NO.**	DESCRIPTION	UNIT	QUANTITY	UNIT COST

ADDITIONAL DATA AND REMARKS

* By Owner

** Identify parts provided by this contract with two asterisks.

Note: Attach additional sheets if necessary; identify each sheet at top with equipment number and description.

"EXAMPLE" FORM 2 TO SECTION 01730 EQUIPMENT DATA FORM				Page 1 of 4
PROJECT NAME	Anytown			
CONTRACT NO.	A			
CONTRACTOR	C.M. Jones, Inc.			
EQUIPMENT NO.	P-8-5-1, P-8-5-2	ASSET NO.*		
DESCRIPTION	Sodium Hydroxide Feed Pump	MAINT. NO.*		
LOCATION	Chemical Feed Building			
MANUFACTURER	Viking Pumps			
PURCHASED FROM	Wilson Equipment Sales			
VENDOR ORDER NO.	AB-7654-A	PURCHASE \$	800.00	
DATE OF PURCHASE	February 30, 199-			
LOCAL SUPPLIER	Wilson Equipment Sales			
ADDRESS	7632 E. Main Street, Goodplace, WI 99999			
PHONE NO.	317-821-6734			
MODEL NO.	CC3670			
NO. OF UNITS	2	SERIAL NOS.	M63A769832-A / M63A769832-B	
*By Owner				

"EXAMPLE"
FORM 2 TO SECTION 01730
EQUIPMENT DATA FORM

Page 2 of 4

NAMEPLATE DATA

ELECTRIC MOTOR		PUMP/HVAC UNIT	
MANUFACTURER	Westinghouse	MANUFACTURER	Viking
TYPE	<input checked="" type="checkbox"/> AC <input type="checkbox"/> DC	TYPE	Rotary Gear
HORSEPOWER	3/4	SIZE	1-inch
RPM	1,750	CAPACITY	9.0 gpm
VOLTAGE	460	PRESSURE	14 psig
AMPERAGE	1.4 F.L.	ROTATION	CW (viewed from shaft)
PHASE	3	IMPELLER SIZE	Not applicable
FRAME	47b	IMPELLER MATERIAL	Not applicable
DRIVE/REDUCER		OTHER (I&C)	
MANUFACTURER	Westinghouse	MANUFACTURER	
TYPE	<input checked="" type="checkbox"/> GEAR	TYPE	
	<input type="checkbox"/> V-BELT		
	<input type="checkbox"/> CHAIN	SIZE	
	<input type="checkbox"/> VARIDRIVE		
SERVICE FACTOR		CAPACITY	
RATIO	1:1	RANGE	

Page 3 of 4

[illegible]

"EXAMPLE"
FORM 2 TO SECTION 01730
EQUIPMENT DATA FORM

Page 4 of 4

LUBRICANT/RECOMMENDED SPARE PARTS LIST

EQUIPMENT NO.	P-8-5-1, P-8-5-2	ASSET NO.*	
DESCRIPTION	Sodium Hydroxide Feed Pump	MAINT. NO.*	

LUBRICANT LIST

REFERENCE SYMBOL	LUBRICANT TYPE (MILITARY STANDARD)	RECOMMENDED LUBRICANT AND MANUFACTURER
List symbols in "maintenance operation" (Page 3).	List general lubricant type.	List specific lubricant name, viscosity, and manufacturer.
1,4	Lithium base ball bearing grease	Texaco TH268
5	Machine oil	AGMA 76

RECOMMENDED SPARE PARTS LIST

PART NO.**	DESCRIPTION	UNIT	QUANTITY	UNIT COST
**2-368-001-921	Mechanical Seal	1	1	
2-461-001-861	Head-O-Ring	1	1	7.82

ADDITIONAL DATA AND REMARKS

* By Owner

** Identify parts provided by this contract with two asterisks.

Note: Attach additional sheets if necessary; identify each sheet at top with equipment number and description.

**FORM 3 TO SECTION 01730
CONTRACTOR SUBMITTAL FORM**

Page 1 of 5

TO: (Engineer) (Address) (City, State, Zip) (Attn:)		DATE:	
		SPECIFICATION SECTION TITLE:	
		SECTION NO.:	
		MANUFACTURER/ VENDOR:	
FROM: (Contractor) (Address) (City, State, Zip)		NO. OF COPIES SUBMITTED TO ENGINEER:	
		SIGNATURE OF CONTRACTOR:	

GENTLEMEN:

We have checked the O&M manual submittal dated _____, 19__, and have found it to be in accordance with the requirements of Specification Section 01730 as noted below.

FORMAT

Size: 8½ x 11 or 11 x 17
 Paper: 20-lb minimum
 Text: Printed data/neatly typed
 Drawings: Standard size bound in text; in text-size labeled envelopes
 Tabbed Section Dividers
 Cover Label: Title
 Project name
 Building/structure ID
 Equipment name
 Specification section
 Binders: Plastic Cover

**FORM 3 TO SECTION 01730
CONTRACTOR SUBMITTAL FORM**

Page 2 of 5

Provided	Not Applicable	Page No.	
GENERAL CONTENTS			
			■ One specification only
			■ Title Page
			- Title
			- Project title
			- Building/structure ID
			- Equipment name
			- Specification section number
			- Contractor ID
			- Subcontractor ID
			- Purchase order data
			- Manufacturer ID
			- Service/parts supplier ID
			■ Product List
			■ Table of Contents
			■ Tabbed Sections
			- Pertinent data sheets
			- Annotated as needed
			■ Text
			- Pertinent to project
			- Annotated
			■ Drawings
			- Illustrate product and components
			- Control and flow diagrams

**FORM 3 TO SECTION 01730
CONTRACTOR SUBMITTAL FORM**

Page 3 of 5

Provided	Not Applicable	Page No.	
GENERAL CONTENTS			
			■ Special Information
			- Interrelationships of equipment and components
			- Instructions and procedures provided
			- Instructions organized in consistent format
			- Instructions in logical sequence
			- Glossary
			■ Warranty, Bond, Service Contract
SPECIFIC CONTENTS (EQUIPMENT/SYSTEMS ONLY)			
			■ Description of Unit and Components
			- Equipment functions
			- Normal operating characteristics
			- Limiting conditions
			- Performance curves
			- Engineering data
			- Test data
			- Replaceable parts list (with numbers)
			- Nameplate data
			- P&ID numbers
			■ Operating Procedures
			- Startup
			- Routine/normal operation
			- Regulation and control
			- Stopping and shutdown
			- Emergency

**FORM 3 TO SECTION 01730
CONTRACTOR SUBMITTAL FORM**

Page 4 of 5

Provided	Not Applicable	Page No.	
<i>SPECIFIC CONTENTS (EQUIPMENT/SYSTEMS ONLY)</i>			
			■ Operating Procedures (continued)
			- Seasonal operation
			- Special instructions
			■ Maintenance Procedures
			- Routine/normal instructions
			- Troubleshooting guide
			- Disassembly/reassembly/repair
			■ Servicing and Lubrication
			- List of lubricants
			- Lubrication schedule
			- Maintenance schedule
			■ Safety Precautions/Features
			■ Sequence of Operation of Controls
			■ Assembly Drawings
			■ Parts List and Illustrations
			- Predicted life
			- Spare parts list
			■ Control Diagrams/Schematics
			■ Bill of Materials
			■ Completed Equipment Data Form per Specification
			■ Other Data as Required

**FORM 3 TO SECTION 01730
CONTRACTOR SUBMITTAL FORM**

Page 5 of 5

Provided	Not Applicable	Page No.	
<i>SPECIFIC CONTENTS (EQUIPMENT/SYSTEMS ONLY)</i>			
			■ Description
			- Equipment functions
			- Normal operating characteristics
			- Performance curves
			- Engineering data
			- Test data
			- Replaceable parts list (with numbers)
			- Nameplate data
			- P&ID numbers
			■ Panelboard Directories
			- Electrical
			- Controls
			- Communications
			■ Instrumentation Loops
			- Diagrams
			- Components list each circuit/loop
			■ Maintenance Procedures
			- Routine/normal instructions
			- Troubleshooting guide
			- Disassembly/reassembly
			- Adjusting and checking
			■ Safety Precautions/Features
			■ Spare Parts List
			■ Additional Data

* * * END OF SECTION * * *

SECTION 01737
ELECTRICAL SYSTEM DEMONSTRATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Demonstrate proper operation of electrical systems and equipment in presence of ENGINEER.

1.02 SUBMITTALS

- A. Demonstration log.
- B. Submit in accordance with Section 01340.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 PERFORMANCE

- A. Demonstrations:

- 1. Each piece of equipment.
- 2. Each integrated system.

- B. Demonstration Log:

- 1. Keep log of individual demonstrations.
- 2. Data:
 - a. Date and time of demonstration.
 - b. OWNER'S representative.
 - c. Equipment or system demonstrated.
 - d. Result of demonstration.
 - 1) Success or fail.
 - 2) If failure, description of failure.
 - 3) Corrective action taken.
 - 4) Redemonstration result.

* * * END OF SECTION * * *

DIVISION 2 - SITE WORK

**SECTION 02100
SITE PREPARATION AND MAINTENANCE**

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Clearing and grubbing.
2. Stripping topsoil.
3. Demolition and miscellaneous surface features.
4. Removal and hauling of scrap metal.

B. For Trench Construction, section additionally includes:

1. Preparation of work platform.
2. Construction of diversion berm, and
3. Relocation of fence and gate.

C. Measurement and Payment:

1. Include cost of Work specified in this section in appropriate lump sum and unit prices specified in Bid Form.

1.02 SUBMITTALS

A. Prepare site preparation and maintenance plan.

1. Describe CONTRACTOR'S procedure for adhering to site preparation and maintenance requirements as outlined in this section.

B. Submit plan to Contract Administrator for review and approval.

1. Approval will be prerequisite for issuance of Notice to Proceed.

1.03 PROJECT/SITE CONDITIONS

- A. Do not block or obstruct roads or streets with excavated or grubbed materials, except as authorized by OWNER.
- B. Protect and maintain on- and off-site roads against damage from equipment and vehicular traffic. Repair damage at no added cost to OWNER.
- C. Provide a flagger to direct traffic in congested area.
- D. Protect existing utilities. CONTRACTOR shall locate existing utilities. Repair damage at no added cost to OWNER.
- E. Conduct operations and maintain Project site so as to minimize creation and dispersion of dust.

1.04 DEFINITIONS

- A. Structures and Surface Features: Existing structures and surface features including buildings, pavements, curb and gutter, signs, posts, fences, trees, shrubs, landscaped surface features, scrap metal and other miscellaneous items.
- B. Utilities: Existing gas mains, water mains, steam lines, electric lines and conduits, telephone and other communication lines and conduits, sewer pipe, cable television, other utilities, and appurtenances.
- C. Clearing and Grubbing: Cutting and disposal of trees, brush, windfalls, logs, and other vegetation, and removing and disposing of roots, stumps, stubs, grubs, logs, and other timber.
- D. Salvaged Topsoil: Natural loam, sandy loam, silt loam, silty clay loam, or clay loam humus-bearing soils available from overlying portions of areas to be excavated for construction.

1.05 METHOD OF MEASUREMENT AND PAYMENT

- A. The Construction Drawings will indicate the entire area that should be prepared in acres. The areas shown on the plans are approximate only. No claims will be allowed for any increase over the estimated area of Site Preparation unless work is performed outside the area shown on the project plans, and then only when such work is caused by a change in the plans approved, in writing, by the OWNER.
- B. The final pay quantity of Site Preparation will be measured as a unit price.
- C. Changes in payment for Site Preparation, due to approved plan changes, will be computed at a unit price based on the unit price provided in the Bid submittal.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials and equipment shall be new or used and adequate in capacity for required usage, shall not create unsafe conditions, and shall meet requirements of applicable codes and standards and approval of Contract Administrator. Soil material required shall be taken from locations on site or from areas of excavation as directed by the Contract Administrator.

PART 3 EXECUTION

3.01 GENERAL

- A. Provide methods, means, and facilities required to prevent contamination of soil, water, atmosphere, uncontaminated structures, equipment or material by discharge of wastes from spills due to CONTRACTOR'S operations.
- B. Provide equipment and personnel to perform emergency measures required to contain spillages and to remove spilled materials and soils or liquids contaminated due to spillage. Collected spill material shall be properly disposed of at no additional cost to OWNER.
- C. Provide equipment and personnel to perform decontamination measures required to remove spillage from previously uncontaminated structures, equipment or material. Decontamination residues shall be properly disposed of at no additional cost to OWNER.
- D. Notify Contract Administrator immediately if unanticipated conditions are encountered.

3.02 PROTECTION

- A. Protect existing utilities against damage.
- B. Contact Ohio Underground Protection, Inc. at 1-800-362-2764.
- C. Locate existing underground utilities by hand excavation.
- D. If uncharted utilities are encountered during excavation, stop work and notify ENGINEER.
 - 1. Repair damaged utilities at CONTRACTOR'S expense.
- E. Preserve and protect groundwater monitoring wells. Replace damaged or destroyed monitoring wells at CONTRACTOR'S expense.
- F. Cap or remove and relocate existing services. Protect, support, and maintain conduits, wires, pipes or other utilities that are to remain in place during work.

3.03 SITE PREPARATION

- A. Provide 3 working days notice, prior to beginning construction, PRP's, Engineer, and to owners of existing utilities, structures, and surface features.
- B. Remove obstructions such as mounds of dirt, stone or debris located within limits of construction. Obstructions such as culverts, end walls, and guard posts may be removed if replaced when need for removal is completed. Replace to original condition.
- C. The contractor shall install and maintain the soil and erosion control measures prior to initializing clearing, grubbing or other earthwork activities.
- D. Access and On-Site Roads:
 - 1. Obtain necessary permission and prepare access and on-site roads as shown on Drawings and as follows.
 - a. Grade, compact, prepare for specified working areas, and to accommodate equipment to be used on roads.
 - b. Gravel Surfacing: For access road, crushed gravel or rock with adequate gradation and fines for compaction. Thickness shall be adequate for CONTRACTOR'S operations.
 - c. Maintain access and on-site roads to provide positive drainage, dust and mud control, and vehicle access. Damage such as washouts and excessive rutting shall be promptly repaired at no additional cost to OWNER.
- E. Fence
 - 1. Relocate fence at western end of the trench/wall alignment to allow for construction activities. The relocated fence shall be six feet high with two strands of barbed wire at the top. The fence and gates shall be located as shown on the drawings. Use existing fence to extent possible. Fence must secure the site at the end of the day's activities.
- F. Diversion Berms
 - 1. Construct berms in accordance with Section 02220.

3.03 SPILL CONTROL

A. Equipment Required:

1. Provide for unexpected spills through provision of following minimum equipment to be kept on-site at all times during site work activities.
 - a. One front end loader, if used for other work such as drum moving.
 - b. Ten drums (55-gal, U.S. DOT 17-E or 16-H).
 - c. Three hand shovels.
 - d. Sorbant pads and other cleanup materials.
 - e. Solvent and other decontamination supplies and equipment for decontamination of tools and equipment.

B. Spills: If spill occurs, take following actions.

1. Immediate action to stop spill and protect/decontaminate affected personnel. Notify Contract Administrator.
2. Implement appropriate action as called for in Site Safety Plan.
3. Take measures to control, confine, and clean up spill. This may include one or more of following actions.
 - a. Keep unnecessary people away, isolate hazardous areas, and deny entry.
 - b. Do not allow anyone to touch spilled material.
 - c. Stay upwind; keep out of low areas.
 - d. Keep combustibles, open flames, and other sources of ignition away from spilled oil.
 - e. Use water spray to reduce vapors, as needed.
 - f. Confine spill and any water used to clean spill to avoid contact with East Fork of Mill Creek.
4. Spill cleanup plans and remedies shall be taken by CONTRACTOR as approved by Contract Administrator.
 - a. Recovered liquids may be handled and disposed of according to procedures for liquids stored on-site.
 - b. Remove contaminated soils on-site to depth of up to 1 ft, drum, and handle as specified for on-site drummed solids. Excavation to less than 1 ft shall be at Contract Administrator's discretion and will require sampling and analysis of residual samples. Excavation shall be restored to approximately original grade with clean fill material.
 - c. Spilled oils flowing to containment pond shall be thoroughly skimmed, drummed or placed in tankage and handled as specified for liquid wastes.
 - d. Decontaminate on-site structures to remove traces of spilled material.
 - e. Spilled solids shall be completely recovered, drummed, and handled as specified for solids.

3.04 CLEARING AND GRUBBING

A. Clear and grub to provide access to construction areas, drives, and where grade is to be razed of shrubs, trees, stumps, vegetation, rubbish, and other perishable or objectionable matter.

1. Remove cleared material from site and relocate to borrow area if suitable material for cap.
2. Clearing and grubbing limits shall be within 20 ft of buildings or tank lines, and as shown on Drawings.

B. Grub stumps to depth of not less than 12 in. below original ground surface or subgrade.

- C. Do not remove or cut down trees unless located within clearing and grubbing limits of excavation as indicated on Drawings.
- D. Do not trim trees unless located within easements or rights-of-way shown on Drawings. Cut interfering tree roots and branches 1 in. or greater in dia perpendicular to direction of growth on tree side of trench.
- E. Remove cleared material from site. Dispose of materials removed by clearing and grubbing in accordance with applicable regulations.

3.05 STRIPPING TOPSOIL

- A. Cut or mow and remove grass, weeds, and other vegetation before stripping topsoil.
- B. Remove topsoil to entire depth in areas where construction is to be performed and where grade is to be raised. Stockpile where indicated on Drawings or designated by ENGINEER. Stockpile for proper drainage.
- C. Provide transportation of material and sites for stockpiles if adequate areas are not available within easements and areas shown on Drawings.

3.06 DEMOLITION

- A. Demolition includes cutting and breaking out existing concrete and masonry, and removal of equipment, piping, pavement, utilities, structures, and surface features in direct conflict with Work or required to be demolished as shown on Drawings.
- B. Salvage and dispose of material according to OWNER's directions.
- C. Protect utilities, structures, surface features, facilities, and groundwater monitoring/sampling wells which are to remain in-place.

3.07 RESTORATION

- A. Restore existing utilities, surface features, and structures to condition equal to condition which existed prior to construction.
- B. Replace to original condition or better, damaged landscape work within and outside of construction limits in accordance with Section 02930.

3.08 PROJECT CLOSEOUT

- A. Repair access and on-site roads if damaged during Work activities to condition equal to that at completion of site preparation. Clean up debris and other site damage resulting from CONTRACTOR'S activities.
- B. Decontaminate vehicles and CONTRACTOR equipment prior to removal from site. Contract Administrator will inspect and approve decontamination of vehicles and equipment prior to removal from Project site.
- C. Package, transport, and dispose of contaminated items, equipment, wastewater, and clothing as specified herein and in accordance with applicable regulations.
- D. Disconnect and remove temporary utilities and structures, excluding equipment decontamination facility.
- E. Complete recordkeeping and documentation and transmit to Contract Administrator.

* * * END OF SECTION * * *

SECTION 02210
SITE GRADING

PART 1 GENERAL

1.01 SUMMARY

A. Change in Removal of Contaminated Soil Material:

1. Include in base Bid, cost of removal of contaminated soil material to limits shown on Drawings and backfill as specified herein.
2. Adjust Contract Price if actual limits of removal of contaminated soil material differ from those shown on Drawings.
3. Pay limits for change in removal of unsuitable material shall be as defined by testing at the time of excavation.
4. Unit cost for change in removal of contaminated soil material shall include cost of excavation and backfilling.

1.02 DEFINITIONS

- A. Influence Zone Around Piping or Electrical Ducts: Area below limits bounded by line 12 in. above pipe or duct and by 1 horizontal to 2 vertical slope extending outward from that line 1-ft beyond outer edge of pipe or duct.
- B. Contaminated Soil: Soil as designated in locations designated on the drawings in the amounts as defined in the bid schedule. The actual extent of the contamination soil will be as determined by ENGINEER at the time of excavation.

1.03 QUALITY ASSURANCE

- A. Testing will be provided by OWNER in accordance with Section 01410.

1.04 PROJECT/SITE CONDITIONS

- A. Notify corporations, companies, individuals or authorities owning above or below ground conduits, wires, pipes or other utilities running to property or encountered during grading operations.
- B. Cap or remove and relocate services in accordance with instructions by owners of said services.
- C. Protect, support, and maintain conduits, wires, pipes or other utilities that are to remain in accordance with requirements of owners of said services.
- D. Utilities are not expected to be encountered at the sites where contaminated soil is identified. If any uncharted utilities or underground obstructions are encountered, notify Contract Administrator prior to proceeding.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. Conform to requirements of Section 02247.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to receive fill to determine existence of areas loosened by frost action, softened by flooding or weather or of unsuitable materials.

3.02 PREPARATION

- A. Fill settled areas where excavations or trenches were backfilled and holes made by demolition, tree removal, and site preparation work.
- B. Natural soils or compacted fill softened by frost, flooding or weather shall be removed, replaced, and compacted.
- C. Proof roll in area to be capped to detect soft or loose zones prior to placing fill. Remove and replace soft or loose zones.
- D. Keep construction site free-draining.
- E. Plow, step, or bench slopes steeper than 1 vertical to 4 horizontal.
- F. Disc level surfaces.

3.03 PLACING FILL

- A. Conform to requirements of Section 02247.

3.04 FIELD QUALITY CONTROL

- A. Rough Grading Tolerances:
 - 1. Grade to 6 in. below finished grade in areas to receive topsoil, unless new grade is less than 4 in. above existing grade. Grade to bottom of base course in areas to receive paving or riprap. Maximum allowable variation from design elevation is 1 in. in 10 ft. Degree of finish shall be ordinarily obtainable from either blade-grader or scraper operations, except as otherwise specified.
 - 2. Rough grading areas, including excavated and filled sections and adjacent transition areas shall be reasonably smooth, compacted, and free from irregular surface changes.
- B. Conform to requirements of Section 02247.
- C. Degree of Compaction: Compact fill materials to at least 95% of Standard Proctor density at -2% to +4% of optimum moisture content.

3.06 ADJUSTMENT AND CLEANING

A. Excess Material:

1. Excess grading material suitable for backfilling or site grading is to be stockpiled on site.
- B. Stockpile material suitable for backfill where indicated on Drawings or designated by ENGINEER. Place no fill where trenches for sewers, water lines or other utilities will be located.
- C. Place material not suitable for backfilling or site grading and unsuitable materials in designated spoil areas and grade to drain. If no spoil areas are provided on-site, remove excess material from site.
- D. Rough grade areas within grading lines and areas which are disturbed to achieve lines and grades indicated on Drawings, with allowance for thickness of pavements, sidewalks, and topsoil.

* * * END OF SECTION * * *

**SECTION 02221
TRENCHING, BACKFILLING, AND COMPACTING**

PART 1 GENERAL

1.01 WORK SUMMARY

- A. This section covers trench work associated with non-force main utility construction. For purposes of this specification section, utilities include: electric, gas, water, sanitary sewer and stormwater.
- B. Measurement and Payment:
 - 1. Comply with Section 01025.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM C33-86 - Standard Specification for Concrete Aggregates.
 - 2. ASTM C136-84a - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 3. ASTM D1140-54 - Standard Test Method for Amount of Material in Soils Finer than No. 200 (75-um) Sieve.
 - 4. ASTM D1557-78 - Standard Test Methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop.
 - 5. ASTM D1586-84 - Standard Method for Penetration Test and Split Barrel Sampling of Soils.
 - 6. ASTM D4253-83 - Standard Test Method for Maximum Index Density of Soils Using a Vibrating Table.
 - 7. ASTM D4318-84 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.03 QUALITY ASSURANCE

- A. Testing will be performed by OWNER in accordance with Section 01410 and this section.

1.04 SUBMITTALS

- A. Shoring and Bracing Construction Procedures and Details: ENGINEER will review submitted material to ascertain shoring effect on new construction. ENGINEER will not review shoring, bracing, and sheet piling construction procedures and details for structural integrity or effect on existing facilities.
- B. Submit in accordance with Section 01340.

1.05 PROJECT/SITE CONDITIONS

- A. Do not block or obstruct pavements (access drives) with excavated materials, except as authorized by ENGINEER. Trim banks to facilitate utility construction.
- B. Sheet piling, Bracing, and Shoring:
 - 1. When close sheet piling is required, drive to prevent soil from entering trench below or through such sheet piling.
 - 2. Fill voids remaining after sheet piling is pulled with sand or other approved material.

- C. Trenching, backfilling, and compacting within influence zone of existing or future structures shall be in accordance with Section 02220.

PART 2 PRODUCTS

2.01 FINE AGGREGATE

- A. Granular material, consisting of durable particles ranging in size from fine to coarse in substantially uniform combination. Unwashed bank-run sand and crushed bank-run gravel will be considered.

1. Gradation No. 1:

Sieve Size	% Passing by Weight
1 in.	100
No. 16	45 - 80
No. 200	2 - 10

2. Gradation No. 2:

Sieve Size	% Passing by Weight
1 in.	100
3/4 in.	85 - 100
3/8 in.	50 - 80
No. 4	35 - 65
No. 40	15 - 30
No. 200	5 - 15

2.02 COARSE AGGREGATE

- A. Crushed stone chips from crushing sound limestone or dolomite ledge rock or other rock materials of regional availability shall be hard, tough, and durable.

1. Gradation No. 1:

Sieve Size	% Passing by Weight
½ in.	100
3/8 in.	90 - 100
No. 8	0 - 15
No. 30	0 - 3

2. Gradation No. 2 (ASTM C33 - Size No. 67):

Sieve Size	% Passing by Weight
1 in.	100
3/4 in.	90 - 100
3/8 in.	20 - 55
No. 4	0 - 10
No. 8	0 - 5

3. Gradation No. 3 (ASTM C33 - Size No. 2):

Sieve Size	% Passing by Weight
3 in.	100
2-1/2 in.	90 - 100
2 in.	35 - 70
1-1/2 in.	0 - 15
3/4 in.	0 - 5

4. Gradation No. 4 (ASTM C33 - Size No. 3):

Sieve Size	% Passing by Weight
2-1/2 in.	100
2 in.	90 - 100
1-1/2 in.	35 - 70
1 in.	0 - 15
1/2 in.	0 - 5

5. Gradation No. 8 (ASTM C136):

Sieve Size	% Passing by Weight
1/2 in.	100
3/8 in.	85 - 100
No. 4	10 - 30
No. 8	0 - 10
No. 16	0 - 5

2.03 FILL MATERIALS

- A. Conform to requirements of Section 02220.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to receive fill to determine existence of areas loosened by frost action, softened by flooding or weather or of unsuitable materials.

3.02 PREPARATION

- A. Notify corporations, companies, individuals or authorities owning above or below ground conduits, wires, pipes or other utilities running to property or encountered during excavating operations.
- B. Cap or remove and relocate services in accordance with instructions by owners of services.
- C. Protect, support, and maintain conduits, wires, pipes, and other remaining utilities in accordance with requirements of owners of said services.
- D. Remove and replace or compact natural soils or compacted fills softened by frost, flooding or weather.
- E. Remove unsuitable material from within trenches.

F. Stabilize utility trench bottom and replace unsuitable material with pea gravel - see Coarse Aggregate Gradation No. 8.

G. Dewatering:

1. Keep construction site free-draining.
2. Keep excavations free from water.
3. Maintain groundwater minimum of 12 in. below excavations.
4. Remove soil which disturbed by pressure or flow of groundwater and replace with free draining material.
5. Maintain dewatering systems to prevent uplifting of structures.
6. Protect adjacent properties from damage resulting from dewatering operations.
7. Dewatering wells shall be drilled, maintained, and abandoned in accordance with federal, state, and local ordinances.

3.03 EXCAVATION

A. Excavate to elevations and dimensions necessary to complete construction.

B. Trenching Tolerances:

1. Excavate so pipes, ducts, and conduits can be laid straight at uniform grade, without sags or humps, between elevations shown on Drawings.
2. Maximum width of excavation at top of pipe shall be outside dia of pipe plus 24 in. When stringers and sheathing required, width of trench may be increased to allow for their use, provided provisions for this excess width of trench are met.
3. Where trench width for that portion of trench depth between trench bottom and outside top of pipe barrel, for any reason within CONTRACTOR'S control, exceeds specified limits, CONTRACTOR, at his expense, shall furnish pipe with strength adequate for actual trench width.
4. Maximum width at surface of ground shall not exceed width of trench at top of pipe by more than 2 ft without permission of ENGINEER, unless specifically shown on Drawings.
5. Minimum trench width shall be outside pipe dia plus 18 in.
6. Excavate electrical duct or conduit trenches as required so top of concrete encasement or top of conduit shall be minimum of 30 in. below final grade or as shown on Drawings.

C. Do not advance excavation of trenches more than 300 ft ahead of completed pipe installation.

D. Do not excavate for manholes and other structures until scheduled for construction.

E. Do not excavate within influence zone of existing footings or foundations without prior approval of ENGINEER.

F. Upon completion of excavation, notify ENGINEER before proceeding with further Work.

G. Excavation of Rigid Surfacing:

1. Remove width 1 ft beyond anticipated edge of excavation.
2. Saw to ensure straight joint.
3. Surface replacement shall match existing surfacing.

H. Excavation Across Roadways: Excavation, backfill, and surface replacement shall conform to requirements of local highway authority. In no case shall surface replacement edges bear on less than 12 in. of undisturbed soil.

3.04 FILL USAGE

A. Bedding Material:

1. Telephone and Electrical conduit for utility trench: pea gravel - see Coarse Aggregate Gradation No. 8.
2. Plastic, Copper, Fiber Glass or Reinforced Plastic Pipe, and Electrical Conduit or Ducts: Fine aggregate gradation No. 1.
3. Other Piping:
 - a. Pipe 18 in. dia or less: Coarse aggregate gradation No. 1.
 - b. Pipe larger than 18 in. dia: Coarse aggregate gradation No. 2.

B. Cover Material:

1. Telephone and Electrical conduit for utility trench: as shown on Drawings.
2. Plastic, Copper, Fiberglass or Reinforced Plastic Pipe and Electrical Conduit: Fine aggregate gradation No. 1.
3. Other Piping: Fine aggregate gradation No. 2.
4. Electrical Ducts: Earth fill.
5. Bedding material may be substituted for cover material.

C. Earth Fill: Other areas not previously specified. Rubble may be used for earth fill under following conditions.

1. Do not bury within vertical projection of influence zone of future construction.
2. Landscaped Areas: Provide minimum of 3 ft of earth fill.
3. Place in single thickness, parallel layers with 6 in. of earth fill between.

3.05 PLACING FILL

A. Notify ENGINEER before placing fill material.

B. Do not use frozen material or place fill on frozen subgrade.

C. Bedding Material Limits:

1. Electric Ducts:
 - a. Hand grade and rake bottom of trench to establish uniform trench gradient not less than 4 in./100 ft.
 - b. Use bedding to bring grade to desired level.
2. Plastic, Copper, Fiberglass or Reinforced Plastic Pipe and Electrical Conduit: Minimum of 6 in. below, to spring line and minimum of 9 in. each side.
3. Other Piping: Minimum of 6 in. below, minimum of 5 in. below bell of pipe, to spring line, and entire trench width.

D. Cover Material Limits:

1. Plastic, Copper, Fiberglass or Reinforced Plastic Pipe and Electrical Conduit: Minimum 6 in. above and 9 in. each side.
2. Other Piping: Minimum 12 in. above and 12 in. each side.

E. Trench backfill beyond limits of cover material specified above shall be as specified elsewhere in this section.

- F. Where pipes or electrical ducts cross, protect piping or ducts at higher elevation by backfilling trench within higher pipe or duct influence zone down to bedding of lower pipe or duct with structural fill or controlled fill.
- G. Where pipes or electrical ducts leave structures, protect by backfilling pipe or duct influence zone down to undisturbed soil with structural fill.
- H. Do not backfill until new concrete has properly cured, and required tests accepted.
- I. Place fill simultaneously on both sides of free-standing structures.
- J. Provide mechanical compaction for cohesive material and vibratory compaction for granular materials.
- K. Lift Thickness and Compaction: Place and compact fill materials in maximum lift thickness and to minimum densities listed below.

Location	Lift Thickness (in.)	Modified Proctor (%)	Relative Density (%)
Bedding Material or Cover Material	6	90	70
Crop Lands	--	80	50

3.06 FIELD QUALITY CONTROL

- A. Testing:
 - 1. One sieve analysis and plasticity index for each source of structural fill, bedding material, and cover material.
 - 2. One liquid limit and plasticity index for each source of controlled fill.
 - 3. One field density test for each 25 cu yds of structural (minimum one each lift) or controlled fill, bedding or cover material.
 - 4. One field density test for each 500 cu yd of earth fill.
- B. Degree of Compaction: ASTM D1557, Method D (Modified Proctor) or ASTM D4253 (Relative Density). Relative density applies to granular soils only.
- C. Moisture Content of Controlled Fill: Within 3% of optimum when placed and compacted.

3.07 ADJUSTMENT AND CLEANING

- A. Stockpile excavated material suitable for backfill on designated site. Place no fill where trenches for sewers, water lines or other utilities will be located.
- B. Place excavated material not suitable for backfilling or site grading and other unsuitable materials in designated spoil areas and grade to drain.

*** END OF SECTION ***

SECTION 02224
EXCAVATING, BACKFILLING, AND COMPACTING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Contaminated soil excavation and restoration.

1.02 DEFINITIONS

- A. Contaminated soil is that material located by BP-01, BP-02, and GW-38, See Drawing 4.4.

1.03 QUALITY ASSURANCE

- A. Testing will be performed by OWNER in accordance with the Field Sampling Plan to confirm all contaminated soil is removed.

1.04 PROJECT/SITE CONDITIONS

- A. Do not block or obstruct access roads with excavated materials, except as authorized by OWNER.

PART 2 PRODUCTS

2.01 EARTH FILL

- A. On-site clayey or sandy soil. Free of wood, peat, vegetable matter or unsuitable material.
- B. On-site soil to be from sources located outside of documented limits of waste.
- C. Free of visual impacts, such as chemical stains, and free from odors.
- D. Test any suspect materials for TCLP parameters.

PART 3 EXECUTION

3.01 PREPARATION

- A. Notify corporations, companies, individuals or authorities owning above or below ground conduits, wires, pipes or other utilities running to property or encountered during excavating operations.
- B. Cap or remove and relocate services in accordance with instructions by owners of services or OWNER if private service lines.
- C. Protect, support, and maintain conduits, wires, pipes, and other remaining utilities in accordance with instruction by owners of services.
- D. Sheeting, Bracing, and Shoring:
 1. When close sheeting is required, drive to prevent soil from entering trench below or through such sheeting.
 2. Fill voids remaining after sheeting is pulled with bentonite sand mixture or other approved material.

- F. Recover initial closure criteria for construction area.

3.02 DEWATERING

- A. Keep construction site free-draining. Keep surface water from contacting refuse.
- B. Keep excavations free from ponded water.
- C. Protect adjacent properties from damage resulting from dewatering operations.
- D. Drill, maintain, and abandon dewatering wells in accordance with federal, state, and local ordinances.
- E. Dispose of leachate encountered during dewatering. OWNER is responsible for leachate disposal.
- F. Restrict discharge to OWNER'S permit conditions.
 - 1. Handle water that has contacted contaminated soil or refuse as leachate.

3.03 EXCAVATION

- A. Excavate to elevations and dimensions necessary to complete construction.
- B. Upon completion of excavation, notify ENGINEER before proceeding with further Work.

3.04 EXCAVATION BACKFILL

- A. Place in 12" lifts and compact to 95% Standard Proctor.
- B. Keep excavation dry.

3.05 CONTAMINATED SOIL DISPOSAL

- A. Transport contaminated soil in covered dump trucks or roll off boxes to disposal area as designated on Drawing 4.5
- B. Spread and compact soil in 12-inch lifts to within 12 inches of the design subbase grades shown on Drawing 4.5.
- C. Cover soil with 12 inches of clean earth fill material to the design subbase grades.
- D. Temporarily cover any exposed contaminated soil overnight with polyethylene sheeting if the 12-inch clean earth cover is not in place.

3.06 WASTE PLACEMENT AND DISPOSAL

- A. Place waste to the required elevation and grade compacting the material to establish a firm surface.
- B. Spread the waste in 24-inch lifts, compact using a tracked dozer or compactor with 4 passes of the equipment, 2 passes north-south and 2 passes east-west.
- C. Cover the exposed waste at the end of each day with 6 inches of intermediate soil cover (general earthfill) or 6-mil polyethylene sheeting if the final cover is not restored over the area.
- D. Place intermediate soil cover (general earthfill) over the waste and compact to establish a firm surface.

3.07 FIELD QUALITY CONTROL

A. General Earth Fill Documentation:

1. Three density tests per acre per lift of compacted earth fill.
2. Degree of Compaction: ASTM D698 (Standard Proctor).

*** END OF SECTION ***

02243
LANDFILL SUBGRADE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grading of existing landfill waste to establish design subbase grade slopes.
- B. Placing general earth fill to establish design subbase grade slopes.

1.02 DEFINITIONS

- A. Subgrade: The subgrade will be the foundation on which the cover system will be placed.

1.03 QUALITY ASSURANCE

- A. OWNER will perform construction quality assurance (CQA) as defined in Construction Quality Assurance Plan (CQAP) for the installation of lining systems for Skinner Landfill Superfund Site, Butler County, Ohio.

1.04 METHOD OF MEASUREMENT AND PAYMENT

- A. In fill areas, the quantity of soil fill in-place, completed and accepted in final work, will be measured in cubic yards based on a record survey performed by a Professional Land Surveyor. The accepted quantities thus measured will be paid for at the contract unit prices per cubic yard.
- B. In cut areas, the quantity of material excavated, completed and accepted in final work, will be measured in cubic yards based on a record survey performed by a Professional Land Surveyor. The accepted quantities thus measured will be paid for at the contract unit prices per cubic yard.

PART 2 PRODUCTS

2.01 SUBGRADE

- A. Properties:
 - 1. The landfill subgrade will be prepared as part of the cover system.
 - 2. The subgrade will be free of organic material.
 - 3. The subgrade will consist of in-place soils and general earth fill.
 - 4. The subgrade should be capable of supporting the landfill cover.
- B. For fill areas, OWNER will provide soil fill from on-site sources.
- C. CONTRACTOR shall be responsible for conducting a reconnaissance of borrow source to verify suitable soil for fill material. Refer to Appendix I for cross-section and boring logs associated with the southern borrow area. The boring logs and related information depict subsurface conditions only at the specific locations and dates indicated. Soil conditions and water levels at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the conditions at these boring locations. The CONTRACTOR is encouraged to perform its own subsurface materials investigation to confirm the general conditions depicted in the boring logs and cross section provided.

PART 3 EXECUTION

3.01 EXAMINATION

- A. The subgrade shall be prepared in accordance with the requirements of the construction drawings and the specifications.
 - 1. Any upper organic layer should be thoroughly stripped within the entire footprints of the construction area and stockpiled separately.
 - 2. In areas where additional fill is required to achieve the design subgrade elevation, prior to placement of fill, adequacy of the existing on-site soils to support the design loads should be verified by observing the amount of deflection and/or rutting which takes place under the wheels of construction equipment.
 - 3. Soft areas identified by proof-rolling should be undercut and replaced by compacted general earth fill.

3.02 EXCAVATION

- A. Excavate within limits of project to lines, grades, and elevations shown on Drawing 4.5.
- B. Transport excavated materials to fill areas, where required.
- C. Maintain surface water control and free drainage during excavation.

3.03 FILL PLACEMENT

- A. Scarify prepared subgrade surface before placement of fill material to provide bonding between fill material and prepared placement areas.
- B. Prior to placement, all fill materials should be classified as general earth fill or rock fill by the Soils Quality Assurance Consultant (SQAC). The classification should be performed at the excavation area prior to placement of fill in the designated fill area or at the designated stockpile.
- C. All fill materials shall be placed in maximum 12-inch loose lifts. However, layers less than 12 inches in loose thickness may be required, when necessary, to obtain the specified density.
- D. Compaction
 - 1. The general earth fill materials shall be compacted to at least 90% of Standard Proctor (ASTM D 698) density.
 - 2. Waste fill materials shall be compacted with a minimum of three (3) passes of compactor or trackdozer weighing 10,000 lbs or with a construction equipment approved by the Construction Quality Assurance Consultant (CQAC) until visual inspection indicates that sufficient compaction was achieved.
- E. At the end of each day, the exposed surface of the subgrade shall be protected from adverse weather conditions.
- F. Any surface which is smooth shall be scarified prior to placement of a subsequent lift.
- G. Equipment used for the compaction of the subgrade shall be approved by the OWNER and CQA Consultant.

3.04 WASTE DISPOSAL AND PLACEMENT

- A. Place waste to the required elevation and grade compacting the material to establish a firm surface.
- B. Spread the waste in 24-inch lifts, compact using a tracked dozer or compactor with 4 passes of the equipment, 2 passes north-south and 2 passes east-west.
- C. Cover the exposed waste at the end of each day with 6 inches of intermediate soil cover (general earthfill) or 6-mil polyethylene sheeting if the final cover is not restored over the area.
- D. Place intermediate soil cover (general earthfill) over the waste and compact to establish a firm surface.

3.05 FIELD QUALITY CONTROL

- A. Survey:
 - 1. After completion of construction of subgrade, a Professional Land Surveyor registered in the State of Ohio should verify all lines and grades.
- B. Construction Testing:
 - 1. The CQA Consultant shall perform field density tests on each lift of compacted, clean earth fill material.
 - 2. Field density tests will not be required for waste fill. Instead, report the compactive effort in the daily log.
- C. Finished Subgrade Condition:
 - 1. Suitable to accept the geocomposite gas venting layer.
 - 2. Clean and free of debris such that there are no rocks, stakes, or other objects left protruding from the subgrade.

* * * END OF SECTION * * *

SECTION 02244
COMPACTED COHESIVE LAYER

PART 1 GENERAL

1.01 SECTION INCLUDES:

- A. Purchase, load, haul, place, compact and preconstruction testing of cohesive soil material from CONTRACTOR supplied off-site borrow source.

1.02 DEFINITIONS

- A. Lift: One layer of cohesive layer material placed in loose lift and compacted to thickness specified.

1.03 QUALITY ASSURANCE

- A. OWNER will perform construction quality assurance (CQA) as defined in Construction Quality Assurance Plan (CQA Plan) for the installation of cover systems for Skinner Landfill Superfund Site, Butler County, Ohio.

1.04 METHOD OF MEASUREMENT AND PAYMENT

The quantity of compacted cohesive layer in-place completed and accepted in final work will be measured in cubic yards based on a record survey performed by a Professional Land Surveyor. The accepted quantities thus measured will be paid for at the contract unit prices per cubic yard.

1.05 SUBMITTALS

- A. List of all construction equipment to be used for the placement, moisture conditioning, and compaction of cohesive soil layer.
- B. A summary of the construction procedures to be used.
- C. Preconstruction data on off-site borrow source for clay quality and quantity.
- D. Procedure to be used to transport material to the site.

PART 2 PRODUCTS

2.01 COHESIVE LINER

- A. Properties:
 - 1. Permeability: 1×10^{-7} cm/sec or less.
 - 2. Grain Size: The maximum percentage by weight of particles larger than 1-inch shall not exceed 2%.
 - 3. Free of tree roots, wood or other decayable materials.
 - 4. Density and moisture content requirements for the cohesive layer during placement should be determined in accordance the procedures suggested in the article titled Water content - density criteria for compacted soil liners, by David E. Daniel and Craig H. Benson published in the Journal of Geotechnical Engineering, American Society of Civil Engineers, Vol. 116, No. 12, December 1990.

- B. CONTRACTOR shall provide cohesive layer material from off-site sources.

PART 3 EXECUTION

3.01 EXAMINATION

- A. The subgrade shall be prepared in accordance with the requirements of the construction drawings and the specification Section 02243 - Landfill Subgrade and the gas venting layer geocomposite layer shall be in place and approved per Section 02418 Geocomposite.
- B. Prior to placing any material over the subgrade, the Construction Quality Assurance Consultant will visually inspect the subgrade to verify that the surface is ready to accept the cohesive layer.

3.02 COHESIVE LINER PLACEMENT

- A. Do not place cohesive soil layer until documentation of installation of subgrade layers is completed by Construction Quality Assurance Consultant and the subgrade is accepted by OWNER.
- B. Placement: The maximum final compacted thickness of the lifts of cohesive layer shall be nine (9) inches for the first lift and six (6) or less thereafter until the required cover thickness is achieved.
- C. Compaction: Moisture and density during placement should be within an acceptable zone determined in accordance with the procedures suggested in the article titled Water content - density criteria for compacted soil liners, by David E. Daniel and Craig H. Benson published in the Journal of Geotechnical Engineering, American Society of Civil Engineers, Vol. 116, No. 12, December 1990. General guidelines are equal to or greater than 95% Standard Proctor and -2 to +4% moisture content and permeability of equal to or less than 1×10^{-7} cm/s.
- D. At the end of each day, the exposed surface of the cohesive layer shall be protected from adverse weather conditions.
- E. Any cohesive layer surface which is smooth shall be scarified prior to placement of a subsequent lift.
- F. Equipment used for the compaction of the cohesive layer shall be approved by the OWNER and Construction Quality Assurance Consultant.
- G. The CONTRACTOR shall be responsible for preparing the materials for the cohesive layer, including but not limited, soil amendment and in-place drying or wetting of the soil necessary to achieve the density and moisture content requirements during placement of the Cohesive Layer.

3.03 FIELD QUALITY CONTROL

- A. Survey:
1. After completion of construction of cohesive layer, a Professional Land Surveyor registered in the State of Ohio shall verify all lines and grades.
 2. Cross-sections will be taken at 100-foot even sections and referenced to existing site control. These cross-sections will be taken to show the completed subgrade elevations. These cross-sections will be used as documentation. Tolerance of 0 to +0.1 ft will be used to verify acceptable work. Tolerances beyond this limit will require OWNER's approval.
 3. The cohesive soil layer shall be at least 18 inches thick. Note: The sideslopes will be constructed at a 3H:1V (3 Horizontal to 1 Vertical) slope and the measurement will be perpendicular to the slope, layer thickness is the perpendicular measurement.

4. The top of the cohesive soil layer should have a minimum slope of five percent to promote positive drainage across the layer surface. The maximum slope of the layer will not be greater than 33 percent.

B. Pre-Construction Testing:

1. Density and moisture content requirements during placement for each material type to be used for the construction of the cohesive soil layer shall be determined in accordance the procedures suggested in the article titled Water content - density criteria for compacted soil liners, by David E. Daniel and Craig H. Benson published in the Journal of Geotechnical Engineering, American Society of Civil Engineers, Vol. 116, No. 12, December 1990.
2. If the procedures provided in 3.02.C. demonstrate that a material type can achieve a permeability less than or equal to 1×10^{-7} cm/sec, Pre-Construction Testing of the Cohesive layer should be performed in accordance with the CQA Plan.
3. The material source shall be accepted by the OWNER based on the results of the tests performed during Pre-Construction Testing.
4. Pre-Construction testing as recommended in U.S. EPA/625/4-91/025 "Design and Construction of RCRA/CERCLA Covers."
5. The CQA Consultant will perform the following tests on the compacted cohesive soil prior to construction.

Testing and Frequency for Material Testing

<u>Parameter</u>	<u>Test Method</u>	<u>Minimum Testing Frequency</u>
Percent Fines	ASTM D1140	1 per 1,000 yd ³
Percent Gravel	ASTM D422	1 per 1,000 yd ³
Liquid & Plastic Limits	ASTM D4318	1 per 1,000 yd ³
Permeability	ASTM D5084	1/10,000 yd ³
Water Content	ASTM D2216	1 per 1,000 yd ³
Moisture Density	ASTM D689	1 per 10,000 yd ³

C. Construction Testing:

1. Conduct Construction Quality Control Testing as recommended in U.S. EPA/625/4-91/025 "Design and Construction of RCRA/CERCLA Covers."
2. The CQA Consultant will perform the following field tests on each lift of compacted cohesive soil layer.

Testing and Frequency for Construction Quality Control

<u>Parameter</u>	<u>Test Method</u>	<u>Cohesive Layer</u>
Field Density (Nuclear)	ASTM D2922	5 per acre, per lift
Field Density (Sand Cone)	ASTM D1556	1 at start of project, 1 at end of project
Natural Moisture Content	ASTM D2216	1/5,000 cy

3. The location of routine in-place density tests may be determined using a non-biased sampling plan.
4. Questions concerning the accuracy of any single test shall be addressed by retesting in the same general location.
5. Rework lifts that fail to meet density or moisture testing. Rework includes:
 - a. Define rework area.
 - b. Disc.
 - c. Moisture condition.
 - d. Compact.
 - e. Retest.

Notify CQA Consultant when reworked area is ready for retest. Reworked areas that fail retesting shall be reworked until they meet the specification or failing material is removed and replaced at no cost to OWNER.

6. If during construction, material differs from previously tested materials, then different material shall be considered unqualified and additional laboratory testing shall be performed to identify characteristics of different material and establish acceptable field moisture and density values.

*** END OF SECTION ***

02245
GEOSYNTHETIC CLAY LINER

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Manufacture, furnishing, and installation of bentonite mat as part of the geosynthetic clay layer secondary barrier layer.

1.02 SUBMITTALS

A. Product data.

B. Submit in accordance with Section 01340.

1.03 DELIVERY, HANDLING, AND STORAGE

A. Roll Identification:

1. Provide bentonite mat rolls wrapped in relatively impermeable and opaque protective covers and marked or tagged with following information.

- a. Manufacturer's name.
- b. Product identification.
- c. Shipping lot.

2. Indicate special handling marked on bentonite mat itself, e.g., "This Side Up".

3. Conformance testing to indicate conformance with Specifications.

B. Handle bentonite mat to ensure bentonite mat is not damaged.

C. Store bentonite mat in dry place under roof or other protective cover, protect from moisture by placing on skids, pallets or dry ground.

D. Damaged mat shall be removed and replaced at no cost to OWNER.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Claymax; McCook, Illinois.

B. Bentomat; American Colloid Company, Arlington Heights, Illinois.

C. Bentofix; National Seal Corporation, Aroura, Illinois.

D. Or equal.

2.02 GENERAL

- A. Except when specifically authorized, do not furnish special run or value added products.
- B. Bentonite Mat:
 - 1. Flexible, layered liner consisting of continuous layer of sodium bentonite sandwiched between primary backing of woven polypropylene and cover spunlace polyester fabric.
 - 2. Stitch bonded or bonded by other method as approved by the ENGINEER.
 - 3. Bentonite mat shall be of type to maintain integrity during installation, placement, and covering procedures.

2.03 BENTONITE MAT PROPERTIES

- A. General Properties:
 - 1. Minimum Dimensions: 12 ft x 50 ft.
 - 2. Thickness: 3/16 in., minimum.
 - 3. Bentonite Mass/Unit Area: 1 lb/sq ft minimum weight.
 - 4. Permeability: 3×10^{-9} cm/sec or less at 1-ft head pressure of water.
- B. Primary Fabric Backing Material:
 - 1. Fabric woven polypropylene fabric, nontoxic, water soluble, nonbiodegradable on one side of bentonite core.
 - 2. Fabric weight: 4 oz/sq yd, minimum.
 - 3. Tensile Strength: 70 lb/in., minimum.
 - 4. Grab Strength: 70 lb/in., minimum.
 - 5. Mullen Burst Strength: 250 lbs/sq in., minimum.
 - 6. Puncture Strength (5/16 mandril): 75 lbs minimum.
 - 7. Filler Fabric: Nylon.
- C. Bentonite Material:
 - 1. Sodium montmorillonite.
 - 2. Mineralogical Composition: 90% montmorillonite minimum.
 - 3. Bentonite graded for mat application.
 - 4. High contaminant-resistance bentonite.
- D. Cover Fabric Material:
 - 1. Fabric: 100% spunlace polyester with open weave to allow for bentonite expansion.
 - 2. Fabric Weight: 1 oz/sq yd, minimum.
 - 3. Grab Strength: Wrap 30 lbs, fill 13.6 lbs.
 - 4. Burst Strength: 35 lbs/sq in.
- E. Adhesive:
 - 1. Water soluble.
 - 2. Nontoxic.

PART 3 EXECUTION

3.01 INSTALLATION

A. Site Preparation:

1. Grade and compact subgrade to provide smooth uniform surface.
2. Lay mat on prepared subgrade free of rocks greater than 1 in. in diameter.
3. Provide grading to allow surface water to be directed away from installation area.

B. General:

1. Place woven polypropylene side up.
2. Position mat by pulling roll suspended by inserting heavy duty 3-in. diameter steel pipe with spreader bar (to prevent damage to mat edge) or suspended roll can be backed down slope and across excavation by supporting vehicle.
3. Lay bentonite mat on sideslopes parallel to flow gradient.
4. Anchor mat in trench by soil backfill to prevent shifting of mat. Do not temporarily anchor by wooden staked.
5. Lay bentonite mat on base so upstream mat overlaps downstream mat.
6. Mat overlap shall be free of dirt to provide seal.
7. Provide 6-inch minimum mat overlap each side.
8. Do not install bentonite mat in rain or standing water.
9. Notify ENGINEER before placing final cover over bentonite mat. Do not cover until ENGINEER as given permission.

C. Temporary Mat Cover:

1. In event of rain, immediately cover exposed mat with plastic sheeting or other methods.

D. Mat Cover:

1. Place geomembrane over mat immediately after ENGINEER's permission to protect from precipitation.
2. Prevent seam damage or mat slippage during backfilling.
3. Cover mat in forward direction working on backfilled areas. Prevent vehicles from operating on mat directly.

E. Repairs and Damaged Mat:

1. Prepare torn or damaged mat by covering 1-ft minimum overlap on sides.
2. Repair pieces shall be stapled, nailed or glued in position without damaging liner layers.
3. If tear exceeds 10% of width of roll on sideslope, remove roll from slope and reduce.
4. Replace damaged liner at no cost to OWNER.

F. Appurtenances:

1. Extend bentonite mat 1 ft and partially hydrated bentonite around protruding appurtenances.
2. After material is placed and overlap checked, complete backfilling after ENGINEER's permission.

* * * END OF SECTION * * *

**SECTION 02247
GENERAL EARTH FILL**

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. General earthfill excavated from on-site borrow source, transported, spread and compacted to shape the existing landfill grades to achieve minimum 5% slope and a maximum 33% slope.
2. Vegetative cover material excavated from on-site borrow source, transported, spread and placed over geomembrane.
3. Cross-section through on-site borrow source and associated boring logs, which are included as Appendix I to these specifications.

B. Related Sections:

1. Landfill Subgrade; Section 02243.

1.02 DEFINITIONS

- A. Unsuitable Material outside of the current waste footprint:** Topsoil, peat, organic soils, and materials containing slag, cinders, foundry sand, debris, and rubble.

1.03 QUALITY ASSURANCE

- A. OWNER** will perform construction quality assurance (CQA) as defined in Construction Quality Assurance Plan (CQA Plan) for the installation of lining systems for Skinner Landfill Superfund Site, Butler County, Ohio.

1.04 METHOD OF MEASUREMENT AND PAYMENT

- A. OWNER** will provide general earth fill from on-site sources.
- B.** The quantity of general earthfill in-place completed and accepted in final work will be measured in cubic yards based on a record survey performed by a Professional Land Surveyor. The accepted quantities thus measured will be paid for at the contract unit prices per cubic yard.

PART 2 PRODUCTS

2.01 GENERAL EARTH FILL

A. Properties:

1. The general earthfill will be free of organic material.
2. The general earthfill will consist of soil fill.

- B. OWNER** will provide soil fill from on-site sources.

2.02 VEGETATIVE COVER MATERIAL

A. Properties.

1. The vegetative cover material will be free from deleterious material that may damage the underlying geomembrane.
2. The vegetative cover will consist of clayey soil, generally CL-ML soils as defined by the Unified Soil Classification System.

B. OWNER will provide vegetative cover material from on-site sources.

PART 3 EXECUTION

3.01 FILL PLACEMENT

- A. Scarify prepared subgrade surface before placement of fill material to provide bonding between fill material and prepared placement areas.
- B. Fill materials shall be placed in maximum 12-inch loose lifts. However, layers less than 12 inches in loose thickness may be required, when necessary, to obtain the specified density.
- C. The maximum size of the particle in the fill should not exceed 12 inches (in any dimension).
- D. The fill materials shall be compacted to at least 95% of Standard Proctor density at -2% to +4% of optimum moisture content (confirm through moisture density testing, ASTM D689).
- E. At the end of each day, the exposed surface of the subgrade shall be protected from adverse weather conditions.
- F. Any surface which is smooth shall be scarified prior to placement of a subsequent lift.
- G. Equipment used for the compaction of the subgrade shall be approved by the OWNER and CQA Consultant.
- H. The CONTRACTOR shall be responsible for preparing the materials for the fill placement, including but not limited to, soil amendment and in-place drying or wetting of the soil necessary to achieve the density and moisture content requirements during placement of the fill.

3.02 PLACEMENT OF VEGETATIVE COVER MATERIAL

A. Placement on Geomembrane:

1. Placement of materials on geomembrane shall not proceed at an ambient temperature below 32° F (0°C) nor above 104°F (40°C) unless otherwise approved by OWNER.
2. Placement of materials on geomembrane should be done during the coolest part of day to minimize development of wrinkles in geomembrane.
3. Equipment used for placing materials shall not be driven directly on geomembrane.
4. Minimum thickness of 1 ft (0.3 m) of materials is specified between light dozer, ground pressure of 5 psi (35 kPa) or lighter, and geomembrane.
5. In areas traversed by vehicles other than low ground pressure vehicles approved by OWNER, soil layer shall have minimum thickness of 3 ft (0.9 m). This requirement may be waived if provisions are made to protect geomembrane through an engineered design. Drivers shall proceed with caution when on overlying soil and prevent spinning of tires or sharp turns.
6. When placing overlying material on geomembrane, minimize wrinkle development. Small wrinkles should be isolated and covered as quickly as possible to prevent their growth. Placement of cover

materials shall be observed by Geosynthetic Quality Assurance Consultant (GQAC) to ensure that wrinkle formation is minimized and that, geomembrane is not folded over on itself. Wrinkles of less than 8 inches (size measured perpendicular to the base grade) shall be "walked out" or otherwise divided to minimize their size. Where wrinkles of greater than 8 inches are present, procedures acceptable to GQAC should be performed to reduce the size. The Geosynthetic Quality Assurance Engineer (GQAE) or Geosynthetic Quality Assurance Monitor (GQAM) shall observe the installation of overlaying material over the geosynthetic to document that no folding of the geosynthetic material occurs.

3.03 FIELD QUALITY CONTROL

A. Survey:

1. After completion of construction of general earth fill, a Professional Land Surveyor registered in the State of Ohio shall verify all lines and grades.

B. Construction Testing.

1. The CQA Consultant shall perform the field density tests on each lift of compacted fill material.
2. The CQA Consultant shall perform the moisture-density relationship testing on the material during construction.
3. Rework lifts that fail to meet density testing. Rework includes:
 - a. Define rework area.
 - b. Disc.
 - c. Moisture condition.
 - d. Compact.
 - e. Retest.

Notify CQA Consultant when rework area is ready for retest. Reworked areas that fail retesting shall be reworked until they meet the specification or failing material is removed and replaced at no cost to OWNER.

* * * END OF SECTION * * *

SECTION 02270
EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope

1. Work shall include providing and installing erosion control matting in completed swales and establishing vegetative cover on all disturbed areas.
2. Work shall include providing, installing and maintaining sediment control measures for use during construction and during post construction while vegetative cover is being established.

B. Definitions

1. Erosion is the washing away of soil.
2. Sediment is soil that has already been eroded.
3. Erosion control is the prevention or minimization of erosion.
4. Sediment control is the trapping of suspended soil particles.

1.02 MEASUREMENT AND PAYMENT

A. Erosion Control - Erosion Matting

1. Measurement - Erosion matting shall be measured for total square yards of area covered with matting. All measurements shall be completed by the Professional Land Surveyor. The OWNER shall determine acceptable work and shall review the quantity measurements.
2. Payment - Payment shall be on a unit price basis for total square yards of area covered with erosion matting. Payment includes purchase, storage, transportation, and installation of the material. Overlapping of material, staples and anchor trenching shall be considered incidental to the work.

B. Sediment Control - Silt Fence

1. Measurement - Silt fencing shall be measured for total lineal footage installed. All measurements shall be completed by the CONTRACTOR. The OWNER shall determine acceptable work and shall review the quantity measurements.
2. Payment - Payment shall be on a unit price basis for total footage of silt fencing installed. Payment includes purchase of the material as described in these specification, storage, transportation, and installation. Disposal of the silt fencing for the replacement event and for the removal event when sediment controls are no longer required shall be incidental to the work.

C. Straw Bales

1. Measurement - Straw bales installed will be counted and paid for by each bale staked in place. All measurements shall be completed by the CONTRACTOR. The OWNER shall determine acceptable work and shall review the quantity measurements.

2. Payment - Payment shall be on a unit price basis for total number of straw bales acceptably constructed, maintained, and removed. Payment includes purchase of the material, storage, transportation, and installation. Disposal of the straw bales for the replacement event and for the removal event when sediment controls are no longer required shall be incidental to the work.

D. Sediment Control Clean-out

1. Measurement - Maintenance and Clean-out of the sediment trapped behind the silt fencing and straw bales shall be incidental to the project work.

1.03 SUBMITTALS

- A. Product literature data on erosion matting.
- B. Description of sediment control method that will be used.
- C. Submit silt fencing sediment control product literature data on geotextile fabric and manufacturer's installation data.

1.04 TRANSPORTATION, HANDLING, AND STORAGE

- A. During shipment and storage, erosion control matting (excelsior mulch blanket and jute fabric) and silt fencing fabric (geotextile) shall be wrapped in relatively impermeable and opaque protective covers.
- B. Storage area shall be such that geotextile and erosion mat are protected from mud, dirt, dust, debris, moisture, and exposure to the sunlight and heat.
- C. Handling, storage, and care of geotextile, erosion control mat, and straw bales on site is responsibility of CONTRACTOR prior to, during, and after their installation. CONTRACTOR shall be liable for all damages to silt fence, erosion control mat, or straw bales prior to final acceptance of installation by OWNER, except for those due to negligent actions on part of OWNER.

PART 2 PRODUCTS

2.01 MATERIALS

A. Excelsior Mulch Blankets

1. The excelsior shall be made from fibers cut from sound, green timber.
2. The blankets shall be made of a uniform web of interlocking fibers with a backing of net on one side only.
3. The blanket shall be produced in the form of a tightly compressed roll not less than 35 inches wide and shall have the net on the outside of the fiber mat.
4. Roll weight when manufactured shall average 0.09 pounds per square foot, ± 10 percent. Weight of each roll shall be presented on roll wrapper or on an attached tag.
5. The net backing shall have a mesh size not larger than 1-1/2 x 2 inches or smaller than 7/8 x 1 inch, shall be fabricated from white polypropylene plastic and fabricated or treated to promote breakdown of the net within the first growing season after replacement. Net shall be in width of not less than 35 inches.

6. Steel wire pins or staples shall be used to anchor the blanket which shall be at least 6 inches long and made from No. 11 wire or other approved material.
7. Manufacturer: North American Green or approved equal.

B. Silt Fence

1. Silt fencing shall consist of geotextile fabric secured to 4 ft long, 1-1/2 inch by 1-1/2 inch hardwood posts on 8-ft centers with reinforcing net.
2. The geotextile fabric shall consist of a 2-ft wide non-woven polypropylene material that meet the following average roll values:

<u>Property/Unit</u>	<u>M.A.R. Value¹</u>	<u>Test Method</u>
Grab Strength, lbs.	100	ASTM D-4632
Burst Strength, psi	200	ASTM D-3786
Apparent Opening Size (AOS) U.S. Standard Sieve	50-140	ASTM D-4751
Ultraviolet Resistance, %	90	ASTM D-4355
Water Flow Rate, gpm/sf	10	ASTM D-4491

¹Minimum Average Roll Values are based on a 95% confidence level.

C. Straw Bales

Straw or hay in air dry condition substantially free of noxious weed seed and other objectional foreign matter.

- D. The ENGINEER shall approve all materials prior to their installation.

PART 3 EXECUTION

3.01 PERFORMANCE

A. Drainage Swale Erosion Control Lining

1. All drainage swales shall be lined with erosion mat as detailed on Drawing 4.13. The method of installation shall conform to the manufacturer's recommendations.
2. The excelsior mulch blankets shall be placed with the netting on top and the straw or fibers in contact with the soil.
3. The blankets shall be butted directly against each other and stapled at maximum intervals of 2.5 ft along joints, edges and center line of the blanket. Staples shall be driven until their tops are flush with the soil.
4. The erosion matting strips shall be rolled on or laid in the direction of the flow. The mat shall be spread evenly, smoothly, in a natural position without stretching and with all parts bearing on the soil.

Adjacent strips shall overlap at least four inches. Strip ends shall overlap at least ten inches. All overlaps shall be made with the upgrade section on top.

5. The upgrade end of each strip of fabric or blanket shall be buried at least six inches in a vertical slot cut in the soil and the soil pressed firmly against the embedded fabric or blanket.

B. Silt Fencing/Ditch Checks

1. Silt fencing is the preferred method of sediment control and shall be installed as detailed on Drawing 4.13.
2. Install with the posts to the downstream direction and the fabric to the upstream direction. The fabric shall be anchored below grade approximately 6 inches. Replace and compact soil in anchor trench to restore to original grade.

C. Straw Bales

1. CONTRACTOR shall have the option to install straw bales upon approval of the ENGINEER.
2. Straw bales shall be installed as detailed on Drawing 4.13.
3. Install with rebars, steel pickets, or 2-in x 2-in. stakes embedded about 18-in. below ground. Straw bales should be placed at least 4-in. below ground.

3.02 MAINTENANCE

- A. The CONTRACTOR shall inspect all erosion control devices immediately after each rainfall and at least daily during prolonged rainfall. Any deficiencies shall be immediately corrected by the CONTRACTOR. In addition, the CONTRACTOR shall make a daily review in areas where construction activity changes the earth contour and drainage runoff, to ensure that erosion control devices are properly located for effectiveness. Where deficiencies exist, additional erosion control devices shall be installed as approved or directed by the OWNER'S representative.
- B. Excessive sediment deposits shall be removed as determined by the OWNER and disposed of as directed by the OWNER. Any sediment deposits remaining in place after erosion control devices are no longer required shall be dressed to conform with the existing grade and the area topsoiled, seeded, fertilized, and mulched as required.
- C. Replace damaged silt fencing as long as sediment control is required.
- D. Upon removal of any straw bales, repair the existing vegetative cover layer by removing all stakes completely, filling intrusions with soil, placing erosion matting, and restoring vegetation.

* * * END OF SECTION * * *

SECTION 02271
DRAINAGE CONTROL STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES:

- A. Construction of all surface water drainage control features for the landfill cover system as shown on Design Drawing 4.7. Surface water drainage systems include:
 - 1. Eastern watershed system consisting of a perimeter swale along the east side of the landfill, an interceptor swale along the top of the southern sideslope, and a down slope flume that conveys flow from the interceptor swale to the perimeter swale.
 - 2. Western watershed system consisting of a northern perimeter swale adjacent to the Duck Pond, a perimeter swale along the west side of the landfill, an interceptor swale along the top of the south and west sideslopes, and a downslope flume that conveys flow from the interceptor swale to the perimeter swale.
 - 3. Central watershed system consists of a central drainage channel and interceptor swales at the southern slope crest that drain to a downslope flume that conveys flow to East Fork of Mill Creek.
 - 4. Southern watershed system consisting of a sheet flow off the southern slopes.
- B. Provide all materials, labor, services, and incidentals necessary for completion of this section of the work.

1.02 RELATED SECTIONS

- A. Section 02243 - Landfill Subgrade
- B. Section 02247 - General Earth Fill
- C. Section 02270 - Erosion and Sediment Control
- D. Section 02272 - Gabions
- E. Section 02930 - Topsoil and Seeding

1.03 MEASUREMENT AND PAYMENT

- A. Construction of surface water drainage features:
 - 1. Measurement - shall be based on square yard of drainage features constructed. All measurements shall be completed by a registered land surveyor. The ENGINEER shall determine acceptable work and shall review the quantity measurements.
 - 2. Payment - shall be on a unit price basis for total square yard of surface water drainage feature constructed. Payment includes finish grading efforts necessary to shape the watershed systems as shown on Drawing 4.7. Cutting and filling to form the rough swale shapes shall be considered part of the earthwork efforts associated with the final cover construction.

1.04 TOLERANCES

- A. Surface Water Drainage Features ± 0.1 ft.

PART 2 PRODUCTS

2.01 MATERIALS

A. Erosion Matting - Refer to Section 02270.

B. Riprap:

1. Material from off-site source shall be sound, hard, dense, field or quarry stone resistant to action of air and water, and free from seams, cracks or other structural defects.
2. Shall be free of objectionable amounts of clay lumps, dirt coatings, and other foreign material.
3. The gradation and thickness requirements for the riprap shall be:

Riprap Size (d_{50}) inches 6
Minimum Riprap Size (inches) 3
Maximum Riprap Size (inches) 9
Minimum Thickness of Riprap (inches) 12

C. Riprap for Stream Bank Protection:

Riprap Size (d_{50}) inches 16
Minimum Riprap Size (inches) 8
Maximum Riprap Size (inches) 24
Minimum Thickness of Riprap with a
geotextile liner (inches) 32

D. Geotextile Filter:

1. Porous non-woven fabric weighing 16 oz/sq.yd. with multiple layers of randomly arranged fibers.
2. Manufactures:
 - a. Trevira 1155
 - b. Or equal.

E. Wire for Gabions - Refer to Section 02272.

F. Gabions - Refer to Section 02272.

G. Stone - Refer to Section 02272.

H. Gravel Filter Layer

1. Coarse Aggregate, refer to Section 02750.

I. Corrugated Metal Culvert Pipe:

1. Fourteen (14) gauge aluminum coated inside and out.
2. Coat uniformly with aluminum material conforming to AASHTO M274 at a minimum rate of 1 oz/sf., measured on crests of corrugations.
3. Average inside dia of circular pipe shall not vary more than $\pm 1/2$ in. or 1%, whichever is greater, from nominal dia.
4. Coupling Bands shall be AASHTO M36, 7 in. wide with two $1/2$ -in. galvanized bolts. Coupling bands may be two numerical thicknesses lighter than that used for pipe, but not less than 0.052 in. thick (18 ga).

5. Metal Apron End Walls shall be manufactured in accordance with requirements of corrugate metal pipe and conform to thickness and dimensions shown on Drawings.
6. Manufacturer: Contech Construction Products or approved equal.

J. Corrugated Polyethylene Culvert Pipe:

1. High density polyethylene pipe with smooth interior pipe manufactured in accordance with AASHTO M294 with material conforming to ASTM D3350.
2. Joints (Coupling Bands) and Fittings shall conform to AASHTO M294 and with material conforming to ASTM D3350. Couplings shall cover two full corrugations on each annular section of pipe.
3. Flared End Sections shall be compatible with the pipe.
4. Manufacturer: Advanced Drainage Systems, Inc. (ADS) N-12 smooth walled pipe, Hancor, Hi-Q, or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Riprap:

1. Place stone riprap to produce reasonably well graded mass of stone with minimum practicable percentage of voids.
2. Place by method preventing segregation of various sizes of stone.
3. Rearrange or shape material to prescribed section after placement and add additional material if sections indicate such to be necessary.
4. Larger stones shall be well distributed throughout mass and finished protection shall be free from pockets of small stones and clusters of large stones.
5. Fill holes or open spots to produce well graded protection.

B. Gabions:

1. Refer to Section 02272.

C. Culvert Piping:

1. Excavate culvert trench in drainage swale to design slope and elevation.
2. Lay pipe in bottom of trench. Remove any sharp edged rock and rock over 6 in. in diameter from the trench bottom before laying the pipe.
3. Pipe joints shall be tight and true and joined in accordance with manufacturer's recommendations.
4. Backfill pipe using excavated material and imported general fill in minimum 12-in. compacted lift thicknesses 24 in. above the pipe to design finish grade.

3.02 DRAINAGE SWALE CONSTRUCTION

- A. Construct surface water drainage features per the lines and grades shown on Drawing 4.7 and detailed on Drawing 4.14.
- B. Drainage swales shall have either a trapezoidal or vee shape.
- C. Finish grade the swale channels to have smooth and uniform sideslopes and channel bottom width.
- D. Channel bottom in trapezoidal shaped swales shall be level from sideslope to sideslope such that flow is uniform in the bottom.

3.03 EROSION CONTROL

- A. Install temporary erosion control mat and blanket in all of the noted drainage swales and on the southern slope, respectively, to the extent noted on the plan and detail drawings.

3.04 VEGETATION

- A. Vegetate all of the noted drainage swales per details specified in Section 02930-Topsoil and Seeding.

* * * END OF SECTION * * *

SECTION 02272
GABIONS

PART 1 GENERAL

1.01 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM C88-83 - Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- B. Federal Specifications (FS):
 - 1. FS QQ-W-461H - Wire, Steel, Carbon (Round, Bare and Coated) (1978).

1.02 SUBMITTALS

- A. Location of source of stone material.
- B. Manufacturer's installation instructions.
- C. Test results.
- D. Material certificates.
- E. Submit in accordance with Section 01340.

1.03 QUALITY ASSURANCE

- A. Testing: Provided by CONTRACTOR in accordance with section.
 - 1. One test on stone for soundness as required herein.
- B. Manufacturer's Services:
 - 1. Furnish on-site supervision of gabion installation at initial stage of construction; be readily available for on-site inspections as required.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Macaferri Gabions, Inc.
- B. Bekaert Gabions.
- C. Or equal.

2.02 MATERIALS

A. Wire for Gabions:

1. Minimal tensile strength of 60,000 psi, FS QQ-W-461H.
2. Gabion shall satisfy the following:

	Galvanized (in.)	PVC Coated (in.)
Wire for Mesh (minimum dia)	0.118	0.105
Wire for Selvedges and Corners (minimum dia)	0.150	0.132
Tie Wire and Stay Wire (minimum dia)	0.087	0.087
Zinc Coating, FS QQ-W-461H, Finish 5, Class 3 (minimum oz/sq ft)	0.80	0.80
PVC Coating (minimum thickness)	-----	0.015

B. Gabion Baskets: Rectilinear shaped boxes made of hexagonal triple twist mesh meeting following requirements.

1. Maximum mesh opening shall not exceed 3 inches by 4 inches.
2. Fabricate so sides, ends, lids, and diaphragms can be assembled at construction site into rectangular basket of specified thickness. Connect ends to base section so strength and flexibility at point of connection is at least equal to mesh.
3. Where basket length exceeds 1-1/2 times its horizontal width, divide by diaphragms placed maximum of 3 ft apart, of same mesh and gauge as body. Secure diaphragms in position on base so no additional tying at this juncture necessary.
4. Selvedge perimeter edges of mesh forming gabion basket so joints formed by tying selvedges have at least same strength as body of mesh.
5. Supply tie wire in sufficient quantity for securely fastening edges of basket and diaphragms and connecting each basket to adjacent baskets.
6. Supply stay wire in sufficient quantity to provide for necessary internal connecting wires in each cell.
7. Baskets for check dams - 6 foot by 3 foot by 1 foot (6' L x 3' W x 1' H).
8. Mattresses for flumes - 12 foot by 6 foot by 9 inches (12' L x 6' W x 9" H).

C. Stone:

1. Well-graded, sound, hard, dense, quarry stone resistant to action of air and water, and free from seams, cracks or other structural defects.
2. Weight loss shall not be more than 20% after 5 cycles when tested by sodium sulfate test method, ASTM C88.
3. Maximum of 5% may pass sieve with openings equal to minimum stone dia.
4. Shape approved by ENGINEER and shall range in size as follows.
 - a. d min - 3 inch diameter
 - b. d 50 - 6 inch diameter
 - c. d max - 9 inch diameter

D. Gravel Filter Layer:

1. Coarse Aggregate, Refer to Section 02750.

PART 3 EXECUTION

3.01 PREPARATION

- A. Grade and dress areas on which gabions are to be placed to lines and grades shown on Drawings.

3.02 INSTALLATION

- A. Place gravel filter layer as shown on Drawings.
- B. Assemble and install baskets in accordance with manufacturer's written recommendations.
 1. Gabion mats shall be of minimum 9 inches thick, measured perpendicular to slope.
 2. Fasten corners and diaphragms with tie wire spaced not more than 6 in. apart. After each basket has been placed, fasten to adjacent baskets in similar fashion.
 3. Fill baskets with stone by mechanical methods or by hand as recommended by manufacturer. Maintain formed rectangular pattern as basket is filled; do not to damage basket or ties.
 4. Alternate transverse joints between adjacent baskets.
 5. Anchor gabions every fifty (50) feet along the slope.

*** END OF SECTION ***

SECTION 02395
SOIL-BENTONITE
SLURRY TRENCH CUTOFF WALL

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: compatability testing, mix design, requirements for the Slurry Trench Cutoff Wall and related work as indicated on the drawings and as hereinafter specified. The work consists of furnishing all plant, labor, equipment, and materials and of performing all operations as required to construct the slurry trench cutoff wall.

1.02 REFERENCES

- A. Following is a list of standards which will be referenced in this specification. Such referenced standards shall be considered part of these specifications as if fully repeated herein.

<u>REFERENCE</u>	<u>TITLE OR DESCRIPTION</u>
API Spec 13A	API Specification for Oil-Well Drilling-Fluid Materials
API RP 13B	API Recommended Practice Standard Procedure for Field Testing Drilling Fluids
ASTM C 138	Density
ASTM C 143	Test Method for Slump of Portland Cement Concrete
ASTM D 1140	Materials Finer than No. 200 Sieve in Mineral Aggregate by Washing
ASTM D 422	Particle Size Analysis of Soils
ASTM D 2216	Moisture Content Determination
ASTM D 4318	Liquid Limit, Plastic Limit and Plasticity Index of Soils
EM 100-2-1906	Permeability Testing

1.03 ABBREVIATIONS AND DEFINITIONS

1. API - American Petroleum Institute
2. ASTM - American Society for Testing and Materials
3. EM - Engineering Manual of the Department of the Army, Corps of Engineers
4. Owner - The Owner as referred to herein is the Implementor.

5. Owner's Representative - The Owner's Representative is designated by the Owner to act on its behalf in the execution of these specifications.
6. Slurry Trench - A narrow vertical-walled trench of specified width excavated by the slurry trench method and backfilled with the specified materials to form a subsurface cutoff wall of limited permeability. The terms "Slurry Trench" and "Slurry Wall" will be used interchangeably in these specifications.
7. Slurry Trench Technique - A method of excavating a narrow vertical-walled trench using a specified slurry mixture to support the trench walls, form a filter cake on and in the trench walls, and prevent movement of groundwater into or through the excavated trench.
8. Water-Bentonite Slurry - A stable colloidal suspension of powdered bentonite in water. The terms "slurry" and "water-bentonite slurry" will be used interchangeably in these specifications.
9. Soil-Bentonite Slurry Backfill - A homogeneous mixture of specified soil material, bentonite and water. The terms "soil-bentonite slurry backfill" and "backfill" will be used interchangeably in these specifications.
10. Slurry Trench Specialist - An individual who has had proven and successful experience in slurry trench construction and is knowledgeable with construction to include: (1) the use, testing and control of bentonite as a slurry, (2) the proper mixing methods employed to mix the slurry and backfill material, (3) excavation and backfill operations, and (4) construction equipment and testing requirements needed for slurry trench construction.
11. Working Platform - The working platform is the surface of the compacted fill and/or excavated surface on which the slurry wall should be constructed.

1.04 QUALIFICATION OF CONTRACTOR

- A. The Contractor shall submit evidence that he is experienced and competent to construct a soil-bentonite slurry trench. This evidence will insure that the Contractor will have sufficient competent experienced personnel to carry out the operations specified. In particular, a slurry trench specialist (as approved by the Engineer) shall supervise the construction, slurry preparation, and quality control. The contractor shall have at least five years of experience in constructing successful slurry walls.

1.05 SCOPE

- A. Slurry Trench Cutoff Wall

An impervious slurry trench cutoff wall shall be constructed to the lines, grades, and cross sections as indicated on the drawings. The trench shall have essentially vertical walls, a minimum width of 24 inches, and shall extend through the overburden and key a minimum depth of 2 to 3 ft into the rock. A generalized description of the overburden through which the slurry trench cutoff wall is to be excavated is indicated by stratigraphy included in the drawings.

1.06 SUBMITTALS

In addition, the following specific information shall be submitted prior to the start of slurry wall construction:

- A. Soil-bentonite slurry mix design and trial mix reports, including mix proportions, density, moisture content, gradations, and hydraulic conductivity on at least four (4) samples of the proposed design mix.
- B. A compatibility test result to verify that the bentonite is compatible with (not degraded by) the groundwater.
- C. Specifications of the batch plant and layouts showing locations of equipment, tanks, pumps, valves, hoses and supply lines.

- D. Source of all imported material, including bentonite. Shipment of materials to the site shall be accompanied by the shipper's written verification of the quality or specification of the material, a copy of which shall be retained by the Contractor.
- E. Certification of bentonite quality, showing compliance with API Standard 13A.
- F. Certification of quality of any admixture.

Upon completion, the Contractor shall submit the results of the quality control testing referenced elsewhere in these specifications.

PART 2 PRODUCTS

2.01 MATERIALS

A. Slurry

Slurry shall consist of a stable colloidal suspension of bentonite in water and shall be controlled in accordance with the most current API Standard 13B, "Standard Procedure for Testing Drilling Fluids," and the following requirements:

1. At the time of introduction of the slurry into the trench, the slurry shall be a mixture of not less than 18 pounds per barrel (42 gallons) of bentonite and water. Additional bentonite may be required depending on the hardness and temperature of the water and the quality of the bentonite. The slurry shall have a minimum apparent viscosity of 15 centipoise or 40 seconds reading through a Marsh Funnel Viscosimeter, and a maximum filtrate loss of 30 cubic centimeters in 30 minutes at 100 psi.
2. The slurry mixture in the trench shall have a unit weight not less than 64 pcf (1.03 gm/cc), not greater than 94 pcf (1.50/gm/cc), or as approved by the Engineer.

B. Bentonite

Bentonite used in preparing slurry shall be pulverized (powder or granular) premium grade sodium cation montmorillonite and shall meet the most current API Standard 13A "API Specifications for Oil-Well Drilling-Fluid Materials."

C. Water

Fresh water, free of excessive amounts of deleterious substances that adversely affect the properties of the slurry shall be used to manufacture bentonite slurry. It is the responsibility of the Contractor that the slurry resulting from the water shall always meet the standards of this specification.

D. Additives

Admixtures of the type used in the control of oil-field drilling muds such as softening agents, dispersants, retarders or plugging or bridging agents may be added to the water or the slurry to permit efficient use of bentonite and proper workability of the slurry. However, no additives shall be used except as approved by the Engineer.

E. Backfill

The material for trench backfilling shall be composed of slurry and selected soils obtained from the designated borrow area or trench spoils. The soil shall be friable and free from roots, organic matter, or other deleterious materials. The backfill shall be thoroughly mixed and reasonably well graded between the following gradation limits:

<u>Screen Size</u> <u>(U.S. Standard)</u>	<u>Percent Passing</u> <u>By Dry Weight</u>
3"	<95%
No. 200	>15%

(NOTE: Backfill design should accommodate, if possible, insitu soils.)

2.02 EQUIPMENT

A. Trench Excavation

Excavation of the slurry trench cutoff wall shall be accomplished by use of any suitable earth-moving equipment such as a backhoe and/or clamshell or combination thereof so that the required width trench can be carried to its final depth of cut continuously along the trench line. Special chopping, chiseling or other suitable equipment may be used as necessary to satisfactorily accomplish the required excavation. The width of the excavating tool shall be equal to or greater than the specified width of the cutoff wall. Additional equipment such as air lift pumps and slurry desanders shall be used if required to clean the trench bottom and/or slurry in accordance with the requirements of the specification.

B. Slurry Batching Plant

The slurry batching plant shall include the necessary equipment, including a mixer capable of producing a colloidal suspension of bentonite in water, pumps, valves, hoses, supply lines, and all other equipment as required to adequately supply slurry to the trench. Storage tanks may be provided (if needed) to store initially mixed slurry to allow hydration and to serve as a reserve in cases where substantial slurry loss from the trench through underlying pervious zones or other reasons may occur. The slurry shall be agitated or recirculated in the storage tanks as required to maintain a homogeneous mix. All slurry for use in the trench shall be prepared using a suitable mixer. No slurry is to be made in the trench. Mixing of water and bentonite shall continue until bentonite particles are fully hydrated and the resulting slurry appears homogeneous.

C. Backfill Mixing and Placing

Equipment for mixing and placing backfill may consist of a suitable type of earthmoving or grading equipment, such as bulldozers, blade graders, or blenders such as a pug mill, that are capable of thoroughly mixing the backfill materials into a homogeneous paste having the required gradation and properties and placing the material in the trench as hereinafter specified.

PART 3 EXECUTION OF WORK

3.01 GENERAL

A. Slurry Trenching

Excavation shall be carried to final depth at the point where excavation is started and then the final depth of cut shall be carried along the line of the trench. Excavation shall proceed continuously from the starting point to the finishing point. Slurry shall be introduced into the trench at the same time trenching is begun and shall be maintained in the trench during excavation and until backfilled. The Contractor shall maintain the stability of the excavated trench

at all times for its full depth. The level of the bentonite slurry shall always be maintained at least 2 ft above groundwater level and shall not be permitted to drop more than 3 ft below the surface of the slurry trench working platform except as approved by the Engineer. The Contractor shall have personnel, equipment, and materials ready to raise the slurry level at any time. To this end, the Contractor shall have personnel on call to raise the slurry level on weekends and/or holidays.

B. Key

Unless otherwise directed, the bottom of the slurry trench will be keyed the minimum specified penetration into the underlying aquiclude beneath the site as indicated by soil borings, except that if the backhoe or clamshell is unable to achieve the minimum specified penetration into weathered rock with the assistance of ripping teeth, blocks or percussion chisels, the minimum penetration requirements will be modified and the trench will extend to the depth where refusal of the excavating equipment is encountered. The final depth and penetration of the trench shall be measured and checked by the Contractor and approved by the Engineer immediately following excavation.

C. Cleaning Trench Bottom

Upon completion of excavation, any loose material or cuttings shall be removed from the bottom of the trench with the excavation tools or other suitable means such as air lift pumps. If the unit weight of the slurry in the trench exceeds the specified limits, or becomes unworkable, the heavy slurry shall be removed from the trench by airlift pump, clamshell, or other methods approved by the Engineer, or the excess solids shall be removed from the slurry by screening or centrifugal-type desander.

D. Backfill Mixing

Material from borrow sources shall be mixed and blended in mechanical blenders or by windrowing, disk harrowing, bulldozing, blading or by other approved methods. Mixing and blending shall be performed in such a manner as to produce the required gradation of backfill. The backfill material shall be thoroughly mixed into a homogeneous mass, free from large lumps or pockets of fines, sand, or gravel. Occasional lumps of up to 6 inches in their largest dimensions will be permitted. Just prior to placing, the backfill material shall have a slump of 3 to 6 inches. To this end, the materials shall be sluiced with slurry during blending operations. Sluicing with water will not be permitted.

E. Backfill Placement

The backfill shall be placed continuously from the beginning of the trench, in the direction of the excavation, to the end of the trench. The toe of the slope of the trench excavation shall precede the toe of the backfill slope so that the toe of the backfill shall not be less than 50 ft following the toe of the excavation, or as required to permit proper cleaning of the trench bottom and to permit inspection and measurement. Placing operations shall proceed in such fashion that the surface of the backfill below the slurry shall follow a reasonably smooth grade and shall not have hollows which may trap pockets of slurry during subsequent backfilling. Free dropping of backfill material through the slurry will not be permitted. Initial backfill shall be placed by lowering it to the bottom of the trenches with clamshell bucket until the surface of the backfill rises above the surface of the slurry trench at the end of the trench. Additional backfill may then be placed in such manner that the backfill enters the trench by sliding down the forward face of the previously placed backfill. To accomplish this, sufficient backfill shall be piled on the edge of the existing backfill to cause a slump and sliding action on the face of the in-place backfill. The backfill shall not be dropped or deposited in any manner that will cause segregation. An acceptable substitute for the initial placing of backfill by the use of a clamshell bucket shall be: begin excavation at a point outside of the limits of work which will provide a sufficient distance for the backfill face to form (i.e., lead-in trench). By pushing the backfill into the trench, the toe of the backfill reaches the point where the cutoff is required.

3.02 TREATMENT FOR TOP OF CUTOFF TRENCH

- A. Upon completion of backfill placement and before drying of the backfill can occur, the cutoff trench shall be capped in accordance with the details shown on the Drawings.

3.03 CLEAN-UP

- A. After completion of the backfill and capping, all remaining excavated material and slurry shall be removed and the surface shall be cleaned and leveled as directed by the Engineer. Excess slurry shall be disposed of by spreading in thin layers on adjacent areas designated by the Engineer.

3.04 FIELD QUALITY CONTROL

- A. The Contractor shall maintain his own quality control for the cutoff wall construction under the direction of a qualified Engineer. Testing requirements are summarized in Table 1 and specified herein.

1. Trench Continuity and Key

The Contractor shall be responsible for demonstrating to the satisfaction of the Engineer that the trench is continuous and keyed the minimum specified depth into the underlying aquiclude. Trench continuity shall be assured by the action of movement of the trench excavation equipment such that the digging tools can be passed vertically from top to bottom of the trench as well as moved horizontally along the axis of the trench without encountering unexcavated material. Penetration of the bottom of the trench into the aquiclude shall be demonstrated by observation of the cuttings removed from the trench and by direct measurement of trench depth to the satisfaction of the Engineer.

2. Slurry and Backfill

a. Materials

Bentonite: Certificate of Compliance with the specification shall be obtained from the material manufacturer.

Backfill Mix: Backfill material shall be tested prior to placement in the trench by conducting tests to determine slump and gradation. Testing frequency will be as directed by the Engineer, and as shown in Table 1.

b. Slurry Introduced in the Trench

A complete series of tests shall be conducted from the mixer or tank containing slurry ready for introduction in the trench at least twice per shift or each time a tank is prepared. The tests shall include:

- Unit weight of the slurry
- Filtrate loss of the slurry
- Viscosity of the slurry

c. Slurry in the Trench

Slurry in the trench shall be tested at least twice per shift. Samples shall be obtained from near the bottom of the trench near the point of trenching and tested for unit weight.

B. Documentation

Results of all tests performed in accordance with the specification will be recorded on forms acceptable to the Engineer and signed by the Contractor's Project Engineer. These forms will be available to the Engineer at all times for his inspection. Copies of all forms will be submitted daily to the Engineer for his reference.

C. Work Plan

The Contractor shall submit a detailed operating plan regarding proposed construction procedures and schedules. This shall include, but not be limited to, the Contractor's plan for:

- A. Coordinating the construction, maintenance and removal of working platforms, mixing pads, and haul roads with the Owner
- B. Site set-up
- C. Material and equipment storage
- D. Water-bentonite slurry mixing, transportation and recirculation
- E. Chemical analysis and supply of water
- F. Control of drainage, spills, wastes, etc.
- G. Quality control
- H. Clean-up

*** END OF SECTION ***

TABLE 1

MATERIALS QUALITY CONTROL PROGRAM
SOIL-BENTONITE
Slurry Trench Cutoff Wall

SUBJECT	STANDARD	TYPE OF TEST	MINIMUM FREQUENCY	SPECIFIED VALUES
MATERIALS				
Water	-	- pH - Total Hardness - Total Organics	Per water source or as changes occur	As required to properly hydrate bentonite with approved additives
Additives	-	Manufacturer certi- cate of compliance	One per truckload	As approved by Engineer
Bentonite	API STD 13A	Manufacturer certi- cate of compliance	One per carload	Premium grade sodium cation montmorillonite
Backfill Soils	ASTM D422 ASTM D4318	Selected soils approved by the Engineer	One per source	Refer to Mix Design
SLURRY				
Prepared for Placement into the trench	API STD 13B	- Unit Weight - Viscosity - Filtrate - pH	2 per shift 4 per shift 1 per truckload 1 per shift	Unit weight ≥ 1.03 gm/cc MFV ≥ 40 sec-Marsh @68° Loss ≤ 30 cc pH ≥ 8
In Trench	API STD 13B 1	- Unit Weight - Viscosity	2 per shift at point of trenching	Unit weight=1.03-1.50gm/cc MFV ≥ 40 sec
BACKFILL MIX				
At Trench	ASTM C 138 ASTM C 143 ASTM D 422 ASTM D 5084	- Unit Weight - Slump - Gradation - Permeability	2 per shift 1 per shift 1 per 100 cy 1 per 100 lf via Shelby Tube	15 pcf \geq slurry density Slump 3 to 6 inches Fines $\geq 15\%$ K $\leq 10^{-7}$ cm/sec

SECTION 02397
BIO-POLYMER SLURRY DRAINAGE TRENCH CONSTRUCTION
GROUNDWATER COLLECTOR TRENCH

PART 1 GENERAL

1.01 SCOPE OF WORK

This section of the specifications includes the minimum requirements for the Groundwater Collector Trench (for groundwater interception and/or extraction) and related work as constructed by the Bio-Polymer Slurry Drainage Trench method (B-P Drain) and as indicated on the drawings and specified hereinafter. The contractor shall perform mix design, provide and furnish all plant, labor, equipment, material, and expertise for performing all operations as required to construct the groundwater collector trench.

The Groundwater Collector Trench shall be constructed with essentially vertical trench walls which shall be supported by an engineered, biodegradable slurry. Gravel backfill, geotextile, observation wells, and extraction wells/sumps shall be placed into the trench, through the slurry. The slurry shall be degraded by the contractor and the collector system fully developed to eliminate any residual effects of the slurry.

A. MEASUREMENT

The groundwater collector shall be measured based on the actual length of trench installed and the depths excavated. Measurements shall be based on surveys of the length and the depth of the trench as measured from the working platform and approved by the Owner's Representative.

B. PAYMENT

Payment for the groundwater collector shall be made at the contract unit prices for groundwater collector trench, geotextile, observation wells, and well/sumps. The price shall include all costs for excavating by the slurry trench method, stockpiling trench spoils, supplying and blending slurry, supplying and placing backfill, supplying and installing geotextile, supplying and installing observation wells, and supplying and installing well/sumps. No separate payment will be made for other items incidental to the construction. Bio-Polymer, additives, equipment, clean up, overtime, testing, and records are included in the price for the groundwater collector trench.

1.02 REFERENCE STANDARDS

Following is a list of standards which will be referenced in this specification. Such referenced standards shall be considered part of these specifications as if fully repeated herein.

<u>REFERENCE</u>	<u>TITLE OR DESCRIPTION</u>
API RP 13B	API Recommended Practice Standard Procedure for Field Testing Drilling Fluids
ASTM C 136	Particle-Size Analysis for Fine and Coarse Aggregates

<u>REFERENCE</u>	<u>TITLE OR DESCRIPTION</u>
ASTM F 480	Standard Specification for Thermoplastic Water Well Casings and Couplings
ASTM A 312	Standard Specification for Seamless and Welded Stainless Steel Pipe
ASTM D 4491	Test Method for Water Permeability of Geotextiles
ASTM D 4632	Test Method for Tensile Properties of Geotextiles
ASTM D 4751	Apparent Opening Size of a Geotextile
AASHTO M 252	Standard Specification for Corrugated Polyethylene Drainage Tubing
ASTM F 405/667	Standard Specification for Corrugated Polyethylene Tubing and Fittings 3"-6"/8"-15"

1.03 DEFINITIONS AND ABBREVIATIONS

1. API - American Petroleum Institute.
2. ASTM - American Standards of Testing Materials.
3. B-P - Bio-Polymer.
4. Owner - The Owner as referenced to herein is the Implementor(s).
5. Owner's Representative - The Owner's Representative is designated by the Owner to act on its behalf in the execution of these specifications.
6. Bio-Polymer Slurry Drainage Trench Technique - A modification of the slurry trench method which uses a biodegradable material instead of bentonite to support narrow, vertical excavations. Abbreviated as B-P Drain.
7. Backfill - A freely-draining gravel used as the final fill for the Groundwater Collection Trench.
8. Working Platform - A relatively level and stable surface of compacted fill and/or excavated earth from which the trench is constructed.
9. Degraded Slurry - Bio-Polymer slurry which through natural or artificial means has degraded to water and a minute amount of a nontoxic residual.
10. Extraction Wells/Sumps - Vertical casings (PVC or Stainless Steel) with well screens [and/or pipe connections] suitable to accept groundwater pumps for the removal of liquids from the completed trench.
11. Groundwater Collector Trench - The completed groundwater extraction/interception trench constructed by the B-P Drain method.
12. Drain Activation - The process by which the Bio-Polymer is degraded to permit the free flow of groundwater into and through the groundwater collector trench.
13. Observation Well - Vertical casings (PVC) with well screen suitable to accept groundwater pumps. These wells are primarily utilized for the observation and measurement of liquid levels within the trench.

1.04 QUALITY ASSURANCE

A. Qualifications of Contractor

The contractor shall submit evidence and references from at least five similar projects constructed over the last five years to document his successful use of the B-P Drain technique. This evidence will ensure that the Contractor will have sufficient expertise in the installation of collector trenches, using slurry trench construction methods, and geotextile wrap around granular drainage material, as well as experienced personnel, proven methodologies and equipment to carry out the work as specified.

In particular, a B-P slurry specialist shall be submitted and approved by the Owner's Representative to supervise the construction, slurry preparations, slurry degradation and quality control. The name and qualifications of the contractor (or specialty subcontractor) shall be submitted with the bid.

B. Groundwater Collector Trench

A freely-draining groundwater collector trench shall be constructed to the lines, grades and cross sections as indicated on the drawings. The trench shall have essentially vertical walls, a minimum width of 24 inches, and shall extend through the overburden to the depth identified on the drawings. A generalized description of the overburden through which the trench is to be excavated is indicated in the Remedial Design Drawing 2.3.

1.05 SUBMITTALS

A. Qualifications

The contractor shall be a specialist in the construction of groundwater collector trenches by the B-P Drain Method.

The contractor shall submit evidence and references from at least five projects constructed over the last five years where collector trenches were installed as a biopolymer slurry and included a geotextile wrap around the drainage material. Project descriptions shall include depth, width, and length of the trench as well as a description of the permanent materials placed in the trench for groundwater extraction. A brief history of each project shall include the type of slurry used, soil conditions and any difficulties encountered in construction and drain development. Submit with the bid.

B. Bio-Polymer Slurry Specialist

The Bio-Polymer Slurry Specialist shall be knowledgeable and experienced in drainage trench construction using Bio-Polymer slurry. This experience shall include, but not necessarily be limited to: 1) the use and control of Bio-Polymer slurry in trench construction; 2) methods required to properly mix and degrade the Bio-Polymer slurry; 3) trench excavating and backfilling procedures; and 4) knowledge of construction equipment and materials testing as required for slurry trench construction. The specialist shall control the mixing, composition, placement, cleaning and maintenance of the Bio-Polymer slurry and backfill. The specialist shall supervise and ensure that the trench is continuous and freely-draining. The credentials of the trench specialist shall be submitted at least one week prior to starting trench construction.

C. Work Plan

The contractor shall submit a preconstruction work plan for approval by the Owner's Representative at least 14 days prior to the start of work under this section. The work plan shall include the following items.

1. Schedule: A schedule in sufficient detail to identify the major segments of the work. Starting and ending dates for all major work items shall be clearly identified.

2. **Bio-Polymer Slurry Trench Construction Method:** A detailed description of the methods of construction which shall include the excavation methods, slurry mixing and handling, material handling and placement, backfill placement, well/sump placement, geotextile placement, etc.
3. **Equipment:** A list of major equipment by type and capacity which shall include excavator, slurry mixer, material handler, support, and transport equipment.

D. Quality Control

The quality control plan shall be submitted along with the work plan.

1. The plan shall include a list of test methods and minimum standards with which to gauge the quality of the work during construction including slurry viscosity, depth measurements, control of well/sump verticality, control of filter fabric overlap, etc.
2. The plan shall address the physical properties and manufacturer's stated properties for all permanent materials including manufacturer's certifications of quality, mill certificates, gradation test data, etc.
3. The plan shall state when all quality control data will be submitted to the Owner and the correction procedures to be employed in the case of substandard results.

E. Waste Disposal Plan

The waste disposal plan shall be submitted along with the work plan.

1. The plan shall include the procedures for removing excess trench spoil and placing it in areas designated by the Implementor.
2. The plan for excess slurry and slurry remaining in the trench shall include degradation, disposal on-site, and drain activation procedures.

PART 2 PRODUCTS

2.01 MATERIALS

A. Biodegradable Bio-Polymer

Biodegradable Bio-Polymer shall naturally degrade or be "broken" to a nontoxic water solution once backfilling of trench is complete. Degraded Bio-Polymer shall not materially reduce trench wall transmissivity. The contractor shall submit the physical and chemical characteristics and properties of the Bio-Polymer with the quality control plan. Substances prohibited by local, state or federal law shall not be contained in the Bio-Polymer. The biodegradable Bio-Polymer shall not form a filter cake on the trench walls which might decrease the transmissivity of the drainage trench/alluvium interface. Unused Bio-Polymer slurry shall convert to water containing a minute residual of nontoxic material once the drainage trench is completed.

B. Water

The water used in preparing the Bio-Polymer slurry shall be fresh or salt water. The water shall be free of excessive amounts of oil, acid, alkali, organic matter and other deleterious substances which could adversely affect the properties of the Bio-Polymer. Potential water sources shall be tested by the contractor prior to beginning trench excavation to assure that water of suitable characteristics for slurry preparation shall be used. Water used in preparing the Bio-Polymer slurry shall have the following minimum properties:

1. pH between 6 and 8
2. total dissolved solids less than 750 mg/l
3. total hardness less than 250 mg/l

It is the responsibility of the contractor to insure that the slurry resulting from mixing water and Bio-Polymer shall always meet the standards of this specification.

C. Slurry

The slurry for supporting the trench shall consist of a stable suspension of biodegradable Bio-Polymer in water. It is the responsibility of the contractor to insure that the slurry meets the necessary properties and monitor the slurry and the trench during excavation. The viscosity, pH and filtrate loss of the slurry will additionally be monitored by the contractor to determine when breakdown of the slurry begins. The gel strength of the slurry shall be maintained at a high level so that hydrostatic pressure is transferred from the slurry to the trench walls.

D. Additives

Admixtures of softening agents, preservatives, dispersants, or retarders may be added to the slurry to permit efficient use of and proper workability of the slurry. The Bio-Polymer slurry may be modified as required for successful trench excavation. Any additives used must be biodegradable and broken down prior to completion of the trench cap. Chemical and physical properties and characteristics of any proposed additives shall be submitted with the quality control plan.

E. Backfill

Durable, clean, washed, and graded gravel shall be used to backfill the trench and meet the following gradation (#4 AASHTO):

<u>Percent Passing</u>	<u>US Standard Sieve</u>
100	2"
90-100	1 1/2"
20-55	1"
0-15	3/4"
0-5	3/8"

F. Geotextile Filter Fabric

A woven, monofilament polypropylene geotextile shall be furnished and installed to separate the backfill from native soils. A material such as Synthetic Industries, Erosion III or approved equal shall be used. This material shall have the following minimum properties:

<u>Fabric Property</u>	<u>Minimum Property</u>
Polymer Composition	Polypropylene
Grab Tensile Strength	360 x 260
Apparent Opening Size	40 US Standard Sieve
Permeability	0.03 cm/sec

H. Extraction and Observation Wells/Sumps

Vertical well/sumps shall be furnished and installed to accept the extraction pumps and permit the free flow of groundwater into the pumps. The well/sump casing shall be constructed of 8-inch diameter Schedule 80 or SDR 21 PVC pipe. The casing shall be factory slotted or fitted with well screens with 0.010 inch slots and capped on the bottom. The casing shall be slotted from the elevation of the trench bottom to a distance above the bottom as shown on Drawings.

I. Access Vault

The well casing shall terminate 3 ft below grade and be covered with a pre-cast, concrete access vault. The access vault shall be sized to allow unimpeded access to the sump for the removal of the pump and accept all necessary discharge plumbing, electrical wiring and controls. Minimum acceptable box dimensions shall be 4-foot-diameter. The access vault shall be leveled and adjusted to match the final grade. The cover for the box shall be traffic-resistant and weigh at least 75 pounds.

J. Pitless Adapter

The casing will be supplied with a pitless adapter for the subsurface discharge of groundwater to the force main. The casing shall extend 2-1/2 ft above the ground surface. Each casing will be supplied with a cap and lock. The well/sumps shall be sized based on the expected groundwater pumping rate and pump dimensions in accordance with the Drawings.

2.02 EQUIPMENT

A. General

The contractor shall furnish all necessary plant and equipment for construction of the facilities shown on the contract documents. The equipment shall be of type and capacity to complete the work in an efficient manner, and shall be maintained in operable condition at all times.

B. Trench Excavation

Equipment for excavating the groundwater collection trench shall be approved earthmoving equipment such as a backhoe and/or clamshell capable of performing the indicated work on the drawings and/or as specified herein. The equipment shall develop a live load surcharge that will produce no significant contribution to the instability of the trench. The equipment shall be capable of excavating to the required trench depth from the working platform. It shall be capable of excavating the required minimum width of the trench in a single pass of the excavating equipment.

C. Slurry Mixing Plant

The contractor shall provide a slurry mixing plant containing the necessary equipment for preparing the Bio-Polymer slurry including a high-shear colloidal mixer capable of producing a stable suspension of Bio-Polymer in water. Pumps, valves, hoses, storage supply lines and other equipment shall be provided as required to adequately supply Bio-Polymer slurry to the trench. The slurry mixing plant shall be equipped with a high-speed/high-shear colloidal mixer [with a static agitator]. Hydration ponds shall not be permitted. The slurry mixing plant shall be subject to approval by the Owner's Representative.

D. Backfill

The backfill shall be installed in the trench, through the slurry, by equipment which minimizes segregation of the gravel and the creation of voids. Initial backfill placement shall be tremied. Subsequent backfill may be placed by filling continuously from the beginning of the trench in the direction of the excavation. All backfill placed around well sumps [and drainage pipes] shall be placed by tremie. Rodding and/or jetting equipment shall be available, if needed, to correct any defects in the backfill placement.

PART 3 EXECUTION

3.01 INSTALLATION

A. General

The drainage trench shall be constructed to the elevations, lines, grades, and cross sections shown on the drawings and in accordance with these specifications, unless otherwise directed by the Owner's Representative.

B. Excavation

Trench excavation shall be maintained in an open condition by the biodegradable slurry method. Excavation shall be conducted in a manner which provides for a continuous minimum width trench to the required depth along the centerline of excavation. The contractor shall excavate the trench immediately to the minimum depth shown on the drawings at the point where excavation is started. The Owner's Representative may direct the point where excavation is started. The Owner's Representative may direct the contractor to deepen the trench based on examination of spoils and shall approve the depth of the trench immediately after excavation. The trench shall be constructed without undue interruption until complete.

D. Mixing and Placing Slurry

1. The Bio-Polymer slurry shall be prepared by mixing water and biodegradable polymer. No slurry shall be made within the trench. The Bio-Polymer slurry shall be prepared in the mixing plant and hydrated in a tank with circulation until the resulting slurry appears homogeneous and meets quality control standards. Additives may be added to the slurry at the mixing plant. The slurry shall be constantly agitated until introduced into the trench. Slurry shall be supplied to the trench through pipelines which shall be extended as necessary to supply the excavation.
2. After the initial 3 ft of soil has been excavated and stockpiled, slurry shall then be introduced into the trench at the time excavation begins. The level of the slurry in open trenches shall be maintained at a level sufficient to maintain trench stability and no more than 3 ft below the ground surface or less than 3 ft above the groundwater table until the placement of filter fabric and backfill material is complete. The contractor shall have sufficient personnel, equipment, slurry storage equipment and stored slurry materials ready to raise the slurry level in the excavated trench during construction. The contractor shall have personnel on call to raise the slurry level at any time, weekends, and/or holidays included. Dilution of slurry by surface water shall be prevented. The quality of the slurry shall be maintained at all times, including periods of work stoppage.

E. Trench Stability

The contractor shall be responsible for maintaining the stability of the excavated trench for its full length and depth and shall be responsible for maintaining slurry densities and levels within specified limits. The contractor shall control surcharges from excavation and backfilling equipment, waste, berm construction, backfill stockpiles, and any other loading situations that may affect trench stability. It is the contractor's responsibility to ensure that any stockpiles do not affect the open trench stability and that open trench stability is maintained at all times. In the event of failure of the trench walls prior to completion of backfilling, the contractor shall at his expense re-excavate the trench and remove all material displaced into the trench and take corrective action to prevent further deterioration as directed by the Engineer.

F. Geotextile

The geotextile shall be installed in panels as wide as practical in order to minimize overlapping joints. Minimum panel width shall be 20 ft and the overlap of each successive panel shall be not less than 4 ft. Each panel shall provide a continuous cover for both sides and the bottom of the trench. Geotextile panels shall be installed immediately prior to placement of backfill material and shall be installed in such a manner as to prevent tears, folds or uncovered areas. After completion of the backfilling operation, excess geotextile shall be cut away and removed.

G. Backfilling

Backfilling of the trench shall commence as soon as practical and be continuous to minimize the area of trench supported only by slurry. The areas for the storage of backfill material shall be approved by the Owner and restored upon completion of the work.

The contractor shall backfill continuously from the beginning of the trench in the direction of the excavation to the end of the trench. The backfill shall be placed into the trench in a manner that avoids trapping pockets of slurry and segregation of the gravel. Free dropping of backfill through the slurry will not be permitted. Initial backfill shall be placed by tremie or similar, approved means until the backfill rises above the surface of the slurry. Subsequent backfill shall proceed to the point where it rises above the slurry and allowed to slide down the slope of previously placed backfill. This method shall continue from the beginning of the trench to the end following in the direction of the excavation.

H. Drain Development and Activation

After completion of backfilling, the slurry shall be degraded to water and residual material. Slurry modifiers shall be added as necessary to destroy the viscosity and filtrate properties of the slurry. The broken slurry shall be oxygenated and pH adjusted to promote slurry degradation and drain activation. Water shall be flushed through the trench backfill material in order to remove residual material and to insure satisfactory hydraulic conductivity through the trench media.

I. Slurry Disposal

Slurry disposal shall be by the contractor on-site in a location designated by the Owner's representative.

J. Treatment of Top of Groundwater Collector

After the trench is developed, the top of the trench shall be covered and backfilled to grade. The geotextile shall be trimmed and overlapped to cover the backfill. A layer of geotextile shall be placed over the backfill to separate the backfill from subsequent soil layers. A minimum of 3 ft of suitable (clayey) native soils, from the trench spoil, shall be recompacted over the backfill to bring the trench to the elevation of the working platform. No recompacted soils shall be placed below the groundwater table.

K. Clean Up

All excavation spoil, unused backfill and water generated during the work shall be properly staged for disposal on-site in an area designated by the Owner's representative. Prior to demobilization, the working platform shall be regraded to promote drainage and all contractor equipment, materials, and personnel removed from the site.

3.02 QUALITY CONTROL

The contractor shall be responsible to ensure that all work is performed to the standards established herein, subject to review and inspection by the Owner. All quality control records, routine tests, observations, and measurements shall be available for inspection by the Owner's Representative. The contractor shall bear the cost of all specified tests.

A. Submittals

The contractor shall make timely submittal of all information required by Section 2.0 to the Owner's Representative. The Owner may review and approve these submittals. Approval of any submittal does not relieve the contractor of the duty to perform the work to the standards specified.

B. Materials

The contractor shall submit data, tests, manufacturer's certificates, etc., to document the compliance of all materials to these specifications.

1. **Bio-Polymer** - The contractor shall submit Material Safety Data Sheets for the Bio-Polymer materials and additives. Test data shall be submitted to document the physical and chemical properties of the Bio-Polymer slurry and degraded slurry.
2. **Water** - The water shall be tested in accordance with API RP 13B as established in Section 3.2.
3. **Gravel** - The supplier shall provide test results documenting the gradation of the gravel prior to construction. The contractor shall perform one additional test for each 500 tons of backfill placed into the trench.
4. **Well/Sump** - The supplier shall provide a letter of certification indicating that the material delivered to the site complies with the specified properties.
5. **Geotextile** - The manufacturer shall supply data sheets along with mill results from the lot of material delivered to the site. The mill results shall indicate the date shipped, lot number, test results, and roll number.

C. Bio-Polymer Slurry

1. The slurry used in trenching shall be tested each shift in accordance with API RP 13B to ensure the ability of the slurry to stabilize the trench. The following tests shall be performed at the indicated minimum frequencies:

Viscosity	4 per shift
Density	4 per shift
pH	4 per shift
Filtrate Loss	1 per shift

Samples of the slurry shall be obtained from both the trench and mixing plant for testing. Equipment and personnel for performing these tests shall be supplied by the contractor.

2. The degraded slurry and water in the trench shall be tested by the contractor to demonstrate that the slurry has been broken. The contractor shall test and monitor the viscosity and pH of the slurry to verify degradation. In addition, the contractor shall pump and flush the trench until the pore volume of the trench has been circulated at least three times.

D. Excavation

The contractor shall make measurements of the trench depth at least every 20 lineal ft. All depth measurements shall be made from the working platform to the bottom of the trench. The contractor shall generate and maintain on site an as-built profile of the trench depth.

E. System Performance

The contractor shall verify the continuity of the system by pumping from a centrally located well/sump and observing an immediate drawdown in other well/sumps in the system.

Additional temporary observation wells may be added by the contractor, as needed, for this test at no additional cost to the Owner. This test shall be performed in the presence of the Owner.

F. Records

Records shall be maintained by the contractor for all testing, measurements, observations, and inspections. Quality Control Reports shall be submitted to the Owner's Representative each day on a form acceptable to the Owner. These reports shall list all test results, measurements, and observations made of the work for that day.

G. Quality Assurance

The Owner reserves the right to perform additional tests, using his own forces, on the slurry and backfill. The Owner's testing will in no way relieve the contractor of the responsibility to perform tests as necessary to meet this specification.

*** END OF SECTION ***

SECTION 02406
LOW DENSITY POLYETHYLENE GEOMEMBRANE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Textured low density polyethylene geomembrane for capping systems.

1.02 SUBMITTALS

A. Pre-installation: Submit prior to geomembrane deployment:

1. Origin (supplier's name and production plant) and identification (brand name and number) of resin used to manufacture geomembrane.
2. Copies of dated quality control certificates issued by resin supplier.
3. Results of tests conducted by geomembrane manufacturer to verify that resin used to manufacture geomembrane meets Specifications.
4. Statement that amount of reclaimed polymer added to resin during manufacturing did not exceed 2% by weight.
5. List of materials which comprise geomembrane, expressed in following categories as percent by weight: polyethylene, carbon black, other additives.
6. Manufacturer's specification for geomembrane which includes properties listed and measured using appropriate test methods.
7. Written certification that minimum values given in manufacturer's specification are guaranteed by geomembrane manufacturer.
8. Quality control certificates, signed by geomembrane manufacturer. Each quality control certificate shall include applicable roll identification numbers, testing procedures, and results of quality control tests.
9. Field panel layout and identification code including dimensions and details.
10. Installation schedule.
11. List of personnel performing seaming operations including experience information.
12. Certificate that extrudate to be used is comprised of same resin as geomembrane to be used.
13. List of seaming devices with identification numbers.

B. Installation: Submit as installation proceeds.

1. Quality control documentation recorded during installation.
2. Subbase surface acceptance certificates signed by EARTHWORK CONTRACTOR, for each area that will be covered directly by geomembrane. Submit prior to geomembrane deployment.
3. Deployment of geomembrane will be considered acceptance of subgrade if certificate is not submitted.
4. Material and Installation Warranty from manufacturer.

C. Submit in accordance with Section 01340.

1.03 QUALIFICATIONS:

1. Manufacturer:

- a. Manufacturer shall have minimum 5 yrs continuous experience in manufacture of geomembrane or experience totaling 2,000,000 sq ft of manufactured geomembrane for minimum of 10 completed facilities.

2. Fabricator (if applicable):

- a. Fabricator shall have minimum 5 yrs continuous experience in fabrication of geomembrane or experience totaling 2,000,000 sq ft of fabricated geomembrane for minimum of 10 completed facilities.

3. Installer:

- a. Installer shall have minimum 5 yrs continuous experience in installation of geomembrane or experience totaling 2,000,000 sq ft of installed geomembrane for minimum of 10 completed facilities.
- b. Personnel performing seaming operations shall be qualified by experience or successfully passing seaming tests. Minimum of one seamer shall have experience seaming minimum 100,000 sq ft of geomembrane using same type of seaming apparatus in use at site. Most experienced seamer, "master seamer," shall provide direct supervision, as required, over less experienced seamers.

1.04 QUALITY ASSURANCE PROGRAM

1. Manufacturer, fabricator, and installer shall participate in and conform with items and requirements of quality assurance program as outlined in this section, and in the document entitled: Construction Quality Assurance Plan (CQAP).

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:

1. Manufacturer shall identify each roll delivered to site with following:
 - a. Manufacturer's name.
 - b. Product Identification.
 - c. Thickness.
 - d. Roll number.
 - e. Roll dimensions.
2. Protect geomembrane from excessive heat, cold, puncture, cutting, or other damaging or deleterious conditions during loading, transport, and unloading at site.

B. Acceptance at Site:

1. Conduct surface observations of each roll for defects and damage. This examination shall be conducted without unrolling rolls unless defects or damages are found or suspected.
2. Defected or damaged rolls or portions of rolls will be rejected and shall be removed from site and replaced with new rolls.
3. Rolls or portions of rolls without identification labeling will be rejected and shall be removed from site.

C. Storage and Protection:

1. CONTRACTOR shall provide storage area for geomembrane rolls from time of delivery until deployment.
2. CONTRACTOR shall protect geomembrane from dirt, water, and other sources of damage.
3. Preserve integrity and readability of geomembrane roll labels.
4. Rolls which do not have proper identification at delivery will not be accepted.

PART 2 PRODUCTS

2.01 MATERIALS

A. Textured Polyethylene Geomembrane Properties:

PROPERTY	METHOD	VALUE
Thickness	ASTM D751	
	mils min. average	40
	mils min. reading	38
Density (geomembrane)	ASTM D1505 g/cc min.	0.940
Melt Index (resin)	ASTM D1238 (Condition 190/2.16) g per 10 minutes, max.	1.0
Tensile Properties: (each direction)	ASTM D638	
	Yield strength (ppi min.)	88
	Break strength (ppi min.)	88
	Elongation at yield (%min.)	13
	Elongation at break (% min.)	240
Modifications to ASTM D638: Type IV Die. ASTM D638 test specimen shall be used. Grip separation shall be 2.5 in. Rate of grip separation will be 2 in. per minute. Gauge length of 1.3 in. for yield values, and 2.0 in. for break values may be used to calculate elongation from grip movement.		
Tear Strength	ASTM D1004	28 lbs min.
Puncture Resistance	ASTM D4833	52 lbs min.
Low Temperature	ASTM D746	-60°C max.
Carbon Black Content	ASTM D1603	2.0 to 3.0%
Carbon Black Dispersion	ASTM D3015	A-1 or A-2
Dimensional Stability (each direction)	ASTM D1204	2.0% max. change
Modification to ASTM D1204: 100°C for 1 hr.		

Environmental Stress Crack	ASTM D1693	1500 hrs min.
Friction	ASTM D35	58° min.

C. Geomembrane shall be manufactured from new polyethylene resin, except as noted below:

1. Use of geomembrane recycled during manufacturing process shall be permitted with written approval from OWNER and if recycled geomembrane does not exceed 2% by weight.
2. Geomembrane manufactured from non-complying resin shall be rejected.

D. Geomembrane Characteristics:

1. Contain maximum of 1% by weight of additives, fillers or extenders (not including carbon black).
2. Contain between 2% and 3% by weight of carbon black for ultraviolet light resistance.
3. No pinholes, bubbles or other surface features that compromise geomembrane integrity. Free of blisters, nondispersed raw materials, or other signs of contamination by foreign matter.

2.02 SEAMING AND TESTING EQUIPMENT

A. Welding:

1. Maintain on-site minimum of 2 spare operable seaming apparatus, unless otherwise agreed upon at pre-construction meeting.
2. Seaming equipment shall not damage geomembrane.
3. Use extrusion welding apparatus equipped with gauges giving temperature of extrudate at nozzle of apparatus, or utilize hand-held gauges to measure extrudate temperatures.
4. Use fusion-welding apparatus which are self-propelled devices equipped with following:
 - a. Gauge indicating temperature of heating element.
 - b. Method of monitoring relative pressure applied to geomembrane.
5. Place electric generator on smooth base such that no damage occurs to geomembrane.

B. Vacuum Testing Equipment:

1. Vacuum box assembly consisting of: rigid housing, transparent viewing window, soft neoprene gasket attached to bottom of housing, porthole or valve assembly, and vacuum gauge.
2. Pump assembly equipped with pressure controller and pipe connections.
3. Pressure/vacuum rubber hose with fittings and connections.
4. Soapy solution to wet test area.
5. Means of applying soapy solution.

C. Air Pressure Testing Equipment:

1. Air pump (manual or motor driven), equipped with pressure ga, capable of generating, sustaining, and measuring pressure between 24 and 35 psi (160 and 240 kPa), and mounted on cushion to protect geomembrane.
2. Rubber hose with fittings and connections.
3. Sharp hollow needle, or other approved pressure feed device.
4. Air pressure monitoring device.

D. Tensiometer Testing Equipment:

1. Tensiometer shall be capable of maintaining constant jaw separation rate of 2 in. per minute, and shall be calibrated, with certificate of calibration less than 1 yr old kept with tensiometer.

2.03 SOURCE QUALITY CONTROL

A. Tests, Inspections shall be performed by geomembrane manufacturer as follows:

1. Test geomembranes to demonstrate that resin meets this Specification.
2. Continuously monitor geomembrane during manufacturing process for inclusions, bubbles, or other defects. Geomembranes which exhibit defects shall not be acceptable for installation.
3. Monitor thickness continuously during manufacturing process.
4. Tests shall be conducted for following properties in accordance with test methods specified.
 - a. Density.
 - b. Carbon black content.
 - c. Carbon black dispersion.
 - d. Thickness.
 - e. Tensile properties.
 - f. Tear strength.
 - g. Puncture resistance.

Perform these tests on geomembrane, minimum of once every 40,000 ft². Samples not complying with Specifications shall result in rejection of rolls. At geomembrane manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify non-complying rolls and to qualify individual rolls.

5. Perform environmental stress crack resistance test on geomembrane at minimum of once every resin lot (typically equivalent to one rail car or 180,000 lbs).
6. Geomembrane manufacturer shall certify that following tests have been performed for each resin used to manufacture rolls for Project in accordance with test methods specified.
 - a. Dimensional stability.
 - b. Low temperature brittleness.
 - c. Multi-axial elongation.
 - d. Friction

PART 3 EXECUTION

3.01 QUALITY CONTROL SAMPLING

A. CONTRACTOR shall make rolls available and assist ENGINEER in obtaining material inventory and material samples.

1. Samples shall be tested in accordance with the test methods specified at frequency of one per 100,000 sq ft.
 - a. Density
 - b. Carbon black content
 - c. Carbon black dispersion
 - d. Thickness
 - e. Tensile properties
 - f. Friction

- B. Rolls represented by quality assurance testing shall be rejected if test failure. CONTRACTOR may at their expense request additional testing to validate individual rolls. Rolls bracketed by passing tests will be allowed to be deployed and seamed.

3.02 PREPARATION

A. Surface Preparation:

1. EARTHWORK CONTRACTOR is responsible for preparing supporting surface for geomembrane placement.
2. After prepared surface has been accepted in accordance with QAM, report to OWNER any change in supporting surface condition that may require repair work. Maintain prepared surface.
3. Do not place geomembrane onto area which has become softened by precipitation or cracked due to desiccation. Observe and report surface condition daily to evaluate degree of softening and desiccation cracking.
4. Repair damage to prepared surface caused by installation activities at CONTRACTOR'S expense.

3.03 INSTALLATION

A. Panel Nomenclature:

1. Field panel is defined as a roll or portion of roll cut and seamed in field, excluding patches and cap strips.
2. Identify each field panel with identification code (number or letter-number) consistent with CONTRACTOR'S layout plan. This identification code shall be agreed upon by OWNER, CONTRACTOR, and ENGINEER.
3. Writing on liner with colored markers shall be as follows:
 - a. CONTRACTOR - white marker.
 - b. Geosynthetic QAC - yellow marker.

Only authorized personnel shall be permitted to write on liner.

B. Protection:

1. Do not use equipment which damages geomembrane.
2. Ensure prepared surface underlying geomembrane has not deteriorated since previous acceptance, and remains acceptable immediately prior to geomembrane deployment.
3. Keep geosynthetic elements immediately underlying geomembrane clean and free of debris.
4. Do not permit personnel to smoke or wear shoes that can damage geomembrane while working on geomembrane. Personnel shall not bring glass bottles on geomembrane.
5. Unroll panels in manner which does not cause excessive scratches or crimps in geomembrane and does not damage supporting soil.
6. Place panels in manner which minimizes wrinkles (especially differential wrinkles between adjacent panels).
7. Prevent wind uplift by providing adequate temporary loading and/or anchoring (e.g., sandbags, tires) that shall not damage geomembrane. In case of high winds, continuous loading is recommended along panel edges.
8. Protect geomembrane in areas where excessive traffic is expected with geotextiles, extra geomembrane, or other suitable materials.

C. Field Panel Deployment:

1. Install field panels at locations indicated on CONTRACTOR'S layout plan.
2. Replace seriously damaged (torn, twisted or crimped) field panels, or portions thereof, at no cost to OWNER. Repair less serious damage as specified. ENGINEER shall determine if material shall be repaired or replaced.
3. Remove damaged panels or portions of damaged panels which have been rejected from work area.
4. Do not proceed with deployment at ambient temperature below 32°F (0°C) or above 104°F (40°C) unless otherwise authorized, in writing, by OWNER.
5. Do not deploy during precipitation, in presence of excessive moisture, (fog, dew), in area of ponded water or in presence of excessive winds.
6. Do not undertake deployment if weather conditions will preclude material seaming on same day as deployment.
7. Do not deploy more geomembrane field panels in one day than can be seamed during that day.

D. Seam Layout:

1. When possible, orient seams parallel to line of maximum slope, i.e., oriented along, not across, slope.
2. When possible, no horizontal seam shall be less than 5 ft (1.5 m) from toe of slope.
3. In general, maximize lengths of field panels and minimize number of field seams.
4. Align geomembrane panels to have nominal overlap of 3 in. (75 mm) for extrusion welding and 4 to 6 in. (100 mm to 150 mm) for fusion welding. Final overlap shall be sufficient to allow peel tests to be performed on seam.

E. Temporary Bonding:

1. Hot air device (Liestar) may be used to temporarily bond geomembrane panels to be extrusion welded.
2. Do not damage geomembrane when temporarily bonding adjacent panels. Apply minimal amount of heat to lightly tack geomembrane panels together. Control temperature of hot air at nozzle of any temporary welding apparatus to prevent damage to geomembrane.
3. Do not use solvent or adhesive.

F. Seaming Methods:

1. Approved processes for field seaming are extrusion fillet welding and fusion welding. Proposed alternate processes shall be documented and submitted to OWNER for approval. Alternate procedures shall be used only after being approved in writing by OWNER.
2. Seams shall meet following requirements:

POLYETHYLENE SEAM PROPERTIES

PROPERTY	METHOD	SPECIFIED VALUE		
MATERIAL THICKNESS		40		
Bonded Seam Strength	ASTM D4437, ppi min	80		
Peel Adhesion:				
Fusion	ASTM D4437, ppi min.	60		
Extrusion	ASTM D4437, ppi min.	52		
Modifications to ASTM D4437: For shear tests, sheet shall yield before failure of seam. For peel adhesion, seam separation shall not extend more than 50 percent of seam width into seam. For either test, testing shall be discontinued when sample has visually yielded. For all tests 4 of 5 samples shall pass for seam to qualify and all shall have a strength value.				

3. Use double-fusion welding as primary method of seaming adjacent field panels.
 - a. For cross seam tees, associated with fusion welding, extrusion weld to minimum distance of 4 in. (100 mm) on each side of tee.
 - b. Place welder on protective pad to prevent geomembrane damage between seaming.
 - c. When subgrade conditions dictate, use movable protective layer (e.g. extra piece of geomembrane) directly below each overlap of geomembrane that is to be seamed to prevent buildup of moisture between sheets and prevent debris from collecting around pressure rollers.
4. Use extrusion fillet welding as secondary method for seaming between adjacent panels and as primary method of welding for detail and repair work.
 - a. Purge heat-degraded extrudate from barrel of extruder under following conditions:
 - 1) Prior to beginning seam.
 - 2) Whenever extruder has been inactive.
 - b. Place smooth insulating plate or fabric beneath hot welding apparatus after usage.
 - c. Use clean and dry welding rods or extrudate pellets.
 - d. Complete grinding process without damaging geomembrane within 1 hr of seaming operation.
 - e. Minimize exposed grinding marks adjacent to extrusion weld. Do not allow exposed grinding marks to extend more than 1/4 in. outside finished seam area.
 - f. Grind perpendicular to seam.

G. Seaming Procedures:

1. General Seaming Procedures: (Ambient temperature between 32°F (0°C) and 104 °F (40°C)).
 - a. Do not field seam without master seamer being present.
 - b. Dry conditions, i.e., no precipitation nor other excessive moisture, such as fog or dew. c.No excessive winds.
 - d. If required, provide firm substrate by using extra piece of geomembrane, or similar hard surface directly under seam overlap to achieve proper support for seaming apparatus.
 - e. Align seams with fewest possible number of wrinkles and fishmouths.
 - f. Extend seams to outside edge of panels placed in anchor trench.

- g. Prior to seaming, ensure that seam area is clean and free of moisture, dust, dirt, debris or foreign material.
- h. Fishmouths or wrinkles at seam overlaps shall be cut along ridge of wrinkle in order to achieve flat overlap. Cut fishmouths or wrinkles shall be seamed and any portion where overlap is inadequate shall be patched with an oval or round patch of same geomembrane extending minimum of 6-in. (150 mm) beyond cut in each direction.
- i. Deploy and seam geomembrane to minimize bridging due to temperature changes that could result in failure of liner.

2. Cold Weather Seaming Procedures (ambient temperature is below 32°F (0°C)).

- a. No seaming of geomembrane is permitted unless demonstrated to OWNER that geomembrane seam quality will not be compromised.
- b. ENGINEER shall determine geomembrane surface temperatures at intervals of at least once per 100 ft of seam length to determine if preheating is required. For extrusion welding, preheating required if surface temperature of geomembrane below 32°F (0°C).
- c. Preheating may be waived by OWNER based on recommendation from ENGINEER, if demonstrated to ENGINEER'S satisfaction that welds of equivalent quality may be obtained without preheating at expected temperature of installation.
- d. If preheating is required, ENGINEER shall observe areas of geomembrane that have been preheated by hot air device prior to seaming, to ensure they have not been subjected to excessive melting.
- e. ENGINEER shall confirm that surface temperatures not lowered below minimum surface temperatures specified for welding due to winds or other adverse conditions. It may be necessary to provide wind protection for seam area.
- f. Preheating devices used shall be pre-approved by OWNER prior to use.
- g. Additional destructive seam tests may be taken at interval between 500 ft and 250 ft of seam length, at ENGINEER'S discretion.
- h. Sheet grinding may be performed before preheating, if applicable.
- i. Trial seaming shall be conducted under same ambient temperature and preheating conditions as actual seams. New trial seams shall be conducted if ambient temperature drops by more than 10°F (3°C) from initial trial seam test conditions. New trial seams shall be conducted upon completion of seams in progress during temperature drop.

3. Warm Weather Procedures (ambient temperature is above 104°F (40°C)).

- a. No seaming of geomembrane is permitted unless demonstrated to OWNER that geomembrane seam quality will not be compromised.
- b. Trial seaming shall be conducted under same ambient temperature conditions as actual seams. New trial seams shall be conducted if ambient temperature rises by more than 5°F (3°C) from initial trial seam test conditions. Such new trial seams shall be conducted upon completion of seams in progress during temperature rise.
- c. At option of ENGINEER, additional destructive seam tests may be required for any suspect areas.

H. Repair Procedures:

- 1. Repair portions of geomembrane exhibiting flaw, or failing destructive or nondestructive test.
- 2. Final decision as to repair procedure shall be agreed upon between OWNER, CONTRACTOR, and ENGINEER.
- 3. Acceptable repair procedures include following:
 - a. Patching: Piece of same geomembrane material extrusion welded into place. Use to repair large holes, tears, nondispersed raw materials, and contamination by foreign matter.

- b. Spot welding or seaming: Bead of molten extrudate placed on flaw. Use to repair, pinholes, or other minor, localized flaws.
 - c. Capping: Strip of same geomembrane material extrusion welded into place over inadequate seam. Use to repair large lengths of failed seams.
 - d. Extrusion welding flap: Bead of molten extrudate placed on exposed flap of fusion weld. Use to repair areas of inadequate fusion seams, which have exposed edge. Repairs of this type shall be approved by ENGINEER and shall not exceed 100 ft (30 m) in length.
 - e. Removal and replacement: Remove bad seam and replace with strip of same geomembrane material welded into place. Use to repair large lengths of failed seams.
4. For each repair method:
- a. Ensure surfaces are clean, dry, and prepared in accordance with specified seaming process.
 - b. Ensure seaming equipment used in repairing procedures meet requirements of this Specification.
 - c. Extend patches or caps at least 6 in. (150 mm) beyond edge of defect. Round corners of patches with radius of approximately 3 in. (75 mm).
5. Do not place overlying layers over locations which have been repaired until appropriate acceptable nondestructive and destructive (laboratory) test results are obtained.

3.04 FIELD QUALITY CONTROL

A. Visual Inspection:

- 1. ENGINEER will examine seam and non-seam areas of geomembrane for identification of defects, holes, blisters, nondispersed raw materials, and any sign of contamination by foreign matter.
- 2. Clean and wash geomembrane surface if ENGINEER determines that amount of dust or mud inhibits examination.
- 3. Do not seam any geomembrane panels that have not been examined for flaws by ENGINEER.
- 4. Nondestructively test seams and any non-seam areas identified by ENGINEER.

B. Trial Seams:

- 1. Make trial seams on fragment pieces of geomembrane liner to verify that conditions are adequate for production seaming.
- 2. Make trial seams at beginning of each seaming period, and at least once each 5 hrs, for each production seaming apparatus used that day. Each seamer shall make at least one trial seam each day.
- 3. Make trial seams under same conditions as actual seams.
- 4. Make trial seams only under observation of ENGINEER.
- 5. Seam overlap shall be as indicated for finished seam.
- 6. Make trial seam sample shall be at least 5 ft (1.6 m) long by 1 ft (0.3 m) wide (after seaming) with seam centered lengthwise.
- 7. Cut 3 specimens from sample with 1 in. (25 mm) wide die. These specimen locations shall be selected randomly along trial seam sample by ENGINEER. Test specimens in peel using field tensiometer. Samples shall exceed the specified peel criteria stated in this Specification.
- 8. If specimen fails, entire trial seam operation shall be repeated. If additional specimen fails, do not use seaming apparatus and seamer until deficiencies are corrected and 2 consecutive successful trial welds are achieved.
- 9. Cut remainder of successful trial seam into three pieces; one to be retained in OWNER'S archives, one to be retained by CONTRACTOR, and one to be retained by ENGINEER for possible laboratory destructive seam testing. If required by OWNER, remaining portion of trial seam sample may be subjected to destructive testing.

C. Nondestructive Seam Testing:

1. General:

- a. Purpose of nondestructive tests is to check continuity of seams. It will not provide quantitative information on seam strength.
- b. Nondestructively test field seams over their full length using vacuum test for extrusion seams, air pressure for double-fusion seams or other OWNER approved method. Document results.
- c. Perform nondestructive testing as seaming work progresses.

2. Vacuum Testing for extrusion seam:

- a. Energize vacuum pump and reduce tank pressure to approximately 5 psi (10 in. of Hg) (35 kPa) gauge pressure.
- b. Wet strip of geomembrane approximately 12 in. by 48 in. (0.3 m by 1.2 m) with soapy solution.
- c. Place box over wetted area.
- d. Close bleed valve and open vacuum valve.
- e. Ensure that leak-tight seal is created.
- f. For minimum of 10 sec, apply vacuum and examine geomembrane through viewing window for presence of soap bubbles.
- g. If no bubbles appear within 10 sec, close vacuum valve and open bleed valve, move box over to next adjoining area with minimum 3 in. (75 mm) overlap and repeat process.
- h. Mark and repair areas where soap bubbles appear.

3. Air Pressure Testing for double-fusion seam:

- a. Seal both ends of seam to be tested.
- b. Insert needle or other approved pressure feed device into air channel created by fusion weld.
- c. Insert protective cushion between air pump and geomembrane.
- d. Pressurize air channel to pressure of approximately 30 psi (200 kPa). Close valve and allow pressure to stabilize for approximately 2 minutes.
- e. Observe air pressure 5 min after initial 2-min stabilization period ends. If pressure loss exceeds Maximum Permissible Pressure Differential of 4 psi or pressure does not stabilize, locate faulty area and repair.
- f. Cut opposite end of tested seam area once testing is completed to verify continuity of air channel. If air does not escape, locate blockage and retest unpressurized area. Repair cut end of air channel.
- g. Remove needle or other approved pressure feed device and repair hole in geomembrane.

4. Inaccessible Seams:

- a. Cap-strip seams that cannot be nondestructively tested.
- b. Cap-strip material shall be composed of same type and thickness geomembrane as geomembrane to be capped.
- c. Examine cap-stripping operations with GEOSYNTHETIC QAC for uniformity and completeness. Document observations.
- d. In accordance with ASTM D4437 mechanical point stress non-destructive test may be used as qualitative measure of edge bonding.

D. Destructive Seam Testing:

1. General:

- a. Purpose of destructive seam testing to evaluate seam strength.
- b. Perform destructive seam test as seaming progresses.
- c. Failed destructive seam sample shall result if grips of testing machine cannot be closed on sample test flap (available flap is ½ in. long or less) due to excessive temporary welding.

2. Location and frequency:

- a. Test at minimum frequency of one test location per 500 ft (150 m) of seam length performed by each welding machine. This minimum frequency to be determined as average taken throughout entire facility.
- b. Test locations shall be determined during seaming, at ENGINEER'S discretion.
- c. CONTRACTOR will not be informed in advance of locations where seam samples will be taken.
- d. OWNER reserves right to increase frequency of testing in accordance with performance results of samples previously tested.

3. Sampling Procedures:

- a. Cut samples at locations chosen by ENGINEER.
- b. ENGINEER shall number each sample and record sample number and location in panel layout drawing.
- c. Repair holes in geomembrane resulting from destructive seam sampling immediately in accordance with repair procedures described in this Specification.
- d. Continuity of repair and seams shall be tested in accordance with vacuum testing requirements.

4. Sample Dimensions: Take two 1-in. wide samples for field testing prior to cutting full laboratory sample.

- a. Field Testing: Cut 1 in. (25 mm) wide samples, 8 inches long with seam centered parallel to width. Distance between these 2 samples shall be 42 in. (1.1 m). Test both samples on field tensiometer in peel. If both samples pass field test, take sample for laboratory testing.
- b. Laboratory Testing: Take laboratory test sample from between samples taken for field testing. Cut sample for laboratory testing 12 in. (0.3 m) wide by 42 in. (1.1 m) long with seam centered lengthwise. Cut this sample into three parts. GEOSYNTHETIC QAC shall distribute parts as follows:
 - 1) One part to CONTRACTOR for optional laboratory testing, 12 in. by 12 in. (0.3 m by 0.3 m).
 - 2) One part to Geosynthetic Quality Assurance Laboratory for testing, 12 in. by 18 in. (0.3 m by 0.5 m).
 - 3) One part to OWNER for archive storage, 12 in. by 12 in. (0.3 m by 0.3 m).
- c. Final determination of sample sizes shall be agreed upon at pre-construction meeting.
- d. Submit laboratory sample for quantitative testing

5. Destructive Test Failure Procedures: When sample fails destructive testing, whether test is conducted by Geosynthetic QAL or by field tensiometer, CONTRACTOR has following options:

- a. Repair seam between any 2 passing destructive test locations.
- b. Trace welding path to intermediate point (10 ft (3 m) minimum from point of failed test in each direction) and take small sample with 1 in. (25 mm) wide die for an additional field test at each

location. If these additional samples pass test, then take full laboratory samples. If these laboratory samples pass tests, repair seam between these locations. If either sample fails, repeat process to establish zone in which seam should be repaired.

- c. Acceptable repaired seams shall be bound by 2 locations from which samples passing laboratory destructive tests have been taken. In cases exceeding 150 ft (50 m) of repaired seam, Geosynthetic QAC may have CONTRACTOR destructive test repair seam.
- d. When sample fails, OWNER may require additional testing of seams that were welded by same welder and/or welding apparatus during same time shift.
- e. Passing laboratory destructive tests of trail seam samples taken as indicated in Section 3.04, B, may be used as boundary for failing seam.

E. Repair Verification:

- 1. GEOSYNTHETIC QAC shall observe number and log each repair.
- 2. Nondestructively test each repair.
- 3. Nondestructive test results that pass shall indicate adequate repair.
- 4. Repairs more than 150 ft long , may require destructive test sampling.
- 5. Failed destructive or nondestructive tests indicate that repair shall be redone and retested until passing test results.

F. Large Wrinkles: Wrinkle is considered to be large when geomembrane can be folded over onto itself.

- 1. When seaming of geomembrane is completed, and prior to placing overlying materials, GEOSYNTHETIC QAC shall identify large geomembrane wrinkles which should be cut and resealed.
- 2. Cut and reseam wrinkles identified by GEOSYNTHETIC QAC. Seams produced while repairing wrinkles shall be nondestructively tested.
- 3. Repair wrinkles identified by GEOSYNTHETIC QAC. Repair during coldest part of installation period.

*** * * END OF SECTION * * ***

SECTION 02415
GEOTEXTILE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Geotextile for protection, separation, and filtering application.

1.02 SUBMITTALS

A. Prior to the installation of geotextile, the Supplier of the geotextiles shall provide the OWNER with the following information:

1. The origin (resin supplier's name and resin production plant) and identification (brand name and number) of the resin used to manufacture the geotextile.
2. Copies of dated quality control certificates issued by the resin supplier.
3. Reports on tests conducted by the Manufacturer to verify that resin used to manufacture the geotextile meets the Manufacturer's resin specifications.
4. Reports on quality control tests conducted by the Manufacturer to verify that the geotextile manufactured for the project meets the project specifications.
5. A specification for the geotextile which includes properties published by the Manufacturer, measured using the appropriate test methods.
6. Written certification that minimum values given in the specification are guaranteed by the Manufacturer.
7. Written certification that the Manufacturer has continuously inspected the geotextile for the presence of needles and found the geotextile to be needle-free.
8. Quality control certificates, signed by a responsible party employed by the Manufacturer. The quality control certificates shall include roll identification numbers, testing procedures and results of quality control tests.

B. Installation: (Landfill) Submit as installation proceeds.

1. Subgrade surface acceptance certificates, signed by CONTRACTOR, for each area that geotextile will be in direct contact with subgrade.
2. Submit prior to geotextile deployment.
3. Deployment of geotextile will be considered acceptance of subgrade if certificate is not submitted.

C. Submit in accordance with Section 01340.

1.03 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping:

1. Manufacturer shall identify rolls of geotextiles with following:
 - a. Manufacturer's name.
 - b. Product identification.
 - c. Roll number.
 - d. Roll dimensions.

B. Storage and Protection:

1. OWNER will provide on-site storage area for geotextile rolls from time of delivery until installed.
2. CONTRACTOR shall protect geotextile from dirt, water, ultraviolet light exposure, and other sources of damage.
3. Preserve integrity and readability of geotextile roll labels.
4. Rolls which do not have proper identification at delivery will not be accepted and will not be allowed on site.
5. The Geosynthetic Quality Assurance Consultant (GQAC) shall observe rolls upon delivery at the site. Any apparently damaged or improperly wrapped rolls shall be reported to the OWNER.

1.04 METHODS OF MEASUREMENT AND PAYMENT

A. OWNER will provide the geotextiles.

B. No separate measurement or payment will be made for fabric when the plans indicate that the geotextile is incidental to the work, or when the specifications for another item requires the incidental installation of geotextile.

For applications where a separate bid item for geotextile is listed in the bid package, geotextile of each type will be measured in square yards. The accepted quantity of geotextile of each type will be paid for at the unit price per square yards.

1.05 QUALITY ASSURANCE

OWNER will perform construction quality assurance (CQA) as defined in Quality Assurance Manual (QAM) for the installation of lining systems for Skinner Landfill Superfund Site, Butler County, Ohio.

PART 2 PRODUCTS

2.01 MATERIALS

A. Supply geotextile in which M.A.R.V. (Minimum Average Roll Values, based on a 95% confidence level) meet or exceed geotextile property values provided below.

B. 7.0 oz/sq. yd Geotextile Properties:

Property	Method	Value
Mass per Unit Area	ASTM D3776	7.0 oz/sq yd min.
Grab Strength	ASTM D4632	210 lb min.
Trapezoidal Tear Strength	ASTM D4533	75 lb min.
Puncture Resistance	ASTM D4833	95 lb min.
Burst Strength	ASTM D3786	360 psi min.

C. 16.0 oz/sq. yd Cushion Geotextile Properties:

Property	Method	Value
Mass per Unit Area	ASTM D3776	16.0 oz/sq yd min.
Grab Strength	ASTM D4632	500 lb min.
Trapezoidal Tear Strength	ASTM D4533	150 lb min.
Puncture Resistance	ASTM D4833	195 lb min.
Burst Strength	ASTM D3786	780 psi min.

D. Geotextiles shall be stock products, i.e., except when specifically authorized in writing by OWNER, geotextile shall not be specifically manufactured to meet this Project.

E. Geotextile shall be comprised of polymeric yarns, or fibers, oriented into stable network which retains its structure during handling and placement.

2.02 SOURCE QUALITY CONTROL

A. Tests:

1. Geotextiles shall be tested by geotextile manufacturer to evaluate characteristics for quality control.
2. Perform quality control tests for every 100,000 ft² of geotextile produced. Samples not satisfying these specifications and manufacturer's specifications shall result in rejection of applicable rolls.
 - a. Mass per unit area.
 - b. Grab strength.
 - c. Trapezoidal tear strength.
 - d. Burst strength.
 - e. Puncture strength.
3. At geotextile manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify noncomplying rolls and to qualify individual rolls.

PART 3 EXECUTION

3.01 EXAMINATION

The Construction Quality Assurance Consultant (CQAC) will review the Quality Control documents and will report any discrepancies with the requirements of this specification to the OWNER. The CQA will document that:

1. Property values certified by the Manufacturer meet its guaranteed specifications.
2. Measurements of properties by the Manufacturer are properly documented and that the test methods used are acceptable.
3. Quality control certificates have been provided at the specified frequency for rolls, and that each certificate identifies the rolls related to it.
4. Roll packages are appropriately labeled.
5. Certified minimum roll properties meet the project specifications.
6. Project specifications and a copy of the QAP will be submitted by the OWNER to the Installer.

3.02 INSTALLATION

A. Landfill

1. Preparation:

- a. During placement of geotextiles, care shall be taken not to entrap in or beneath geotextiles stones, excessive dust, or moisture that could damage geomembrane, cause clogging of drains or filters, or hamper subsequent seaming.

2. Geotextile Deployment:

The Installer shall ensure that geotextiles are not damaged during handling. The geotextile shall be deployed as described below:

- a. On slopes, the geotextiles shall be securely anchored and then rolled down the slope in such a manner as to continually keep the geotextile sheet in tension.
- b. In the presence of wind, geotextiles shall be weighted with sandbags or the equivalent. Such sand bags shall be installed during deployment and shall remain until replaced with cover material.
- c. Geotextiles shall be cut using a geotextile cutter (hook blade) only. If in place, special care shall be taken to protect other materials from damage which could be caused by the cutting of the geotextiles.
- d. The Installer shall take any necessary precautions to prevent damage to underlying layers during placement of the geotextile.
- e. During placement of geotextiles, care shall be taken not to entrap in or beneath the geotextile stones, excessive dust, or moisture that could damage the geomembrane, cause clogging of drains or filters, or hamper subsequent seaming.
- f. The Installer shall perform a visual examination of the geotextile over the entire surface, after installation, to ensure that no potentially harmful foreign objects, such as needles, are present.
- g. The GQAC shall document any noncompliance and report it to the OWNER.

3. Seaming Procedures:

- a. In general, no horizontal seams or splices allowed on side slopes except as part of patch. Splice is defined as seam connecting ends of 2 rolls.
- b. Overlap geotextile minimum of 3 in. (75 mm) prior to seaming.
- c. On slopes steeper than 10:1 (horizontal:vertical), continuously sew geotextiles. Spot sewing not allowed.
- d. On slopes shallower than 10:1 (horizontal:vertical), continuously sew geotextiles, or thermally bond with written approval of OWNER.
- e. Allow no earth cover material to be present beneath geotextile.
- f. Polymeric thread with chemical and ultraviolet light resistance properties shall be used when sewing seams equal to or exceeding those of geotextile.
- g. Use sewing thread color that contrasts with color of geotextile being sewn, to allow for ease of inspection.
- h. Sewing machinery and stitch type shall be approved in writing by the OWNER.

B. Collection Trench

1. Geotextile Deployment

- a. Minimum geotextile panel width shall be 17.5 ft.
- b. Panels shall overlap a minimum of 4 ft.

- c. Panels shall be installed to provide a continuous cover for both sides of the trench and the trench bottom.
- d. Panels shall be installed immediately prior to the placement of backfill material.
- e. Panels shall be installed in such a manner to prevent tears, folds or uncovered areas.
- f. Panel overlap shall be adjusted as the construction approaches the sump location such that a panel is centered on the extraction well sump.
- g. Sufficient geotextile shall be left at the top of the trench to allow for the overlapping of the geotextile prior to "capping" the trench.
- h. Depth measurements shall be made to verify that the geotextile was placed on the bottom of the trench.
- i. If the geotextile is found to be above the trench bottom, the Contractor shall re-install the geotextile at no cost to the OWNER.

3.03 FIELD REPAIR PROCEDURES

A. Identification

If a defect is identified in the geotextile, the CQAC shall determine the extent and nature of the defect. If the defect is indicated by unsatisfactory test results, the CQAC shall determine the extent of the deficient area by additional tests, observations, a review of records and other means that the CQAC deems appropriate.

B. Notification

After determining the extent and nature of the defect, the CQAC shall promptly notify the CONTRACTOR and OWNER. A work deficiency meeting shall be held as required between the CONTRACTOR, CQAC, ENGINEER, OWNER and any other necessary parties to assess the problem, review alternative solutions, and implement an action plan.

C. The final decision as to the appropriate repair shall be agreed upon between the OWNER, ENGINEER, CONTRACTOR, and CQAC.

1. Landfill

Any holes or tears in the geotextile shall be repaired using the following two procedures. On sideslopes, a patch match from the same geotextile shall be sewn into place. The tensile strength of the seam should be equal to greater than the tensile strength of the geotextile. Should any tear exceed 10% of the width of the roll, that roll shall be removed from the slope and replaced. On non-sideslope areas, a patch made from the same geotextile shall be thermally bonded or sewn into place with a minimum of 12-inch overlap in all directions. Care shall be taken to remove any soil or other material which may have penetrated the torn geotextile.

2. Collection Trench

For the collection trench, holes or tears less than 2 ft square may be repaired. A stitch line shall be sown at the end of any now rounded tears to prevent propagation of the tear. After "reinforcing" the corners, a patch of the same material (geotextile) shall be sown into place. The repair shall be positioned in the trench such that the repair is not located within the bottom 3 ft of the trench.

The CQAC shall observe repairs and report any noncompliance with the above requirements in writing to the OWNER. The OWNER should approve repair procedure decisions not included in this QAP.

GEOTEXTILE PROTECTION

Soil materials located on top of a geotextile shall be deployed in such a manner as to ensure:

1. The geotextile and underlying lining materials are not damaged.
2. Minimal slippage of the geotextile on underlying layers occurs.
3. No excess tensile stresses occur in the geotextile.
4. Wrinkles of less than 8 inches (size measured perpendicular to the base grade) shall be "walked out" or otherwise divided to minimize their size. Where wrinkles of greater than 8 inches are present, efforts to reduce the size shall be undertaken. The CQAC shall observe the installation of material over the geosynthetic to observe that no folding of the material occurs.
5. A minimum thickness of 1 foot (0.3 m) of soil is specified between a light dozer, ground pressure of 5 psi (35 kPa) or lighter, and the geotextile. Equipment with ground pressure greater than 5 psi are not permitted on the geotextile during construction unless a minimum thickness of 3 feet of soil is present between the equipment and the geotextile.
6. Any noncompliance with these guidelines or the project specifications shall be documented by the CQAC and reported to the OWNER.

*** * * END OF SECTION * * ***

SECTION 02418
GEOCOMPOSITE (GEOTEXTILE/GEONET)

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Geotextile and geonet used as gas venting and drainage layers in landfill cover system.

1.02 SUBMITTALS

A. Product Data:

1. Origins (supplier's name and production plant) and identifications (brand name and number) of geotextile and geonet used to manufacture geocomposite.
2. Specification for geocomposite which includes properties published by manufacturer measured using specified test methods.

B. Miscellaneous:

1. Copies of dated quality control certificates issued by geotextile and geonet manufacturer.
2. Written certification that minimum average roll values given in manufacturer's specification are guaranteed by geocomposite manufacturer.
3. Quality control certificates signed by geocomposite manufacturer. Quality control certificates shall include roll identification numbers, testing procedures, and results of quality control tests.
4. Subgrade surface acceptance certificates if applicable, signed by CONTRACTOR, for each area that will be covered by geocomposite. Submit prior to geocomposite deployment. Deployment of geocomposite will be considered as acceptance of subgrade if certificate is not submitted.

C. Submit in accordance with Section 01340.

1.03 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping:

1. Manufacturer shall identify rolls of geotextiles with following:
 - a. Manufacturer's name.
 - b. Product identification.
 - c. Roll number.
 - d. Roll dimensions.

B. Storage and Protection:

1. OWNER will provide on-site storage area for geocomposite rolls from time of delivery until installed.
2. After CONTRACTOR mobilization, protect geocomposite from dirt, water, ultraviolet light exposure, and other sources of damage.
3. Preserve integrity and readability of geocomposite roll labels.

PART 2 PRODUCTS

2.01 MATERIALS

A. Geotextile:

1. Supply geotextile in which M.A.R.V. (Minimum Average Roll Values, based on a 95% confidence level).
2. 7.0 oz/sq. yd Geotextile Properties

Property	Method	Value
Mass per Unit Area	ASTM D3776	7.0 oz/sq yd min.
Grab Strength	ASTM D4632	210 lb min.
Trapezoidal Tear Strength	ASTM D4533	75 lb min.
Puncture Resistance	ASTM D4833	95 lb min.
Burst Strength	ASTM D3786	360 psi min.

3. Geotextiles shall be stock products, i.e., except when specifically authorized in writing by OWNER, geotextile shall not be specifically manufactured to meet this Project.
4. Geotextile shall be comprised of polymeric yarns, or fibers, oriented into stable network which retains its structure during handling and placement.

B. Geonet:

1. Geonet Properties:

Property	Method	Value
Thickness	ASTM D1777	200 mils min.
Mass per Unit Area	ASTM D3776 (Option C)	0.16 lb/ft ² min.
Density (geonet)	ASTM D1505	0.940 g/cc min.
Melt Index max. (resin)	ASTM D1238 (Condition 190/2.16)	1.0 g per 10 minutes, max.
Tensile Strength	ASTM D1682	40 lb/in min.
Modifications: Use 4 in. by 8 in. specimens and test at rate of 8 in./minimum. Continue test until first strand completely separates. Report average of 5 tests in machine direction.		
Carbon Black Content	ASTM D1603	2.0-3.0%

2. Transmissivity ASTM D4716 1×10^{-3} m²/sec min.

Modifications: Measure between two steel plates at gradients of 1.0, 0.5, 0.25 and 0.10 and confining pressure of 15,000 psf for leachate collection applications and 4,000 psf for final cover applications. Apply confining pressure at least 1 hr prior to test.

3. Geonet provided shall be stock product, i.e., except when specifically authorized in writing by OWNER, geonet shall not be specifically manufactured to meet this Project.
 4. Capable of retaining structure during handling, placement, and long-term service.
- C. Geotextiles-Geonet adhesion peel resistance shall exceed 2 lb/in. in accordance with ASTM D413.
- D. Geotextiles-geonets used for manufacture of geocomposite shall be stock products except when specifically authorized in writing by OWNER, materials shall not be specifically manufactured to meet this Project.
- E. Capable of retaining its structure during handling, placement and long-term services.

2.02 SOURCE QUALITY CONTROL

A. Tests:

1. Geocomposites shall be tested by geocomposite manufacturer to evaluate characteristics for quality control. At minimum, following tests shall be performed for quality control in accordance with test methods specified.
2. Perform following tests for every 40,000 ft² of geocomposite produced.
 - a. Mass per unit area.
 - b. Geotextile-geonet peel adhesion.
3. At geocomposite manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify noncomplying rolls and to qualify individual rolls.
4. Geocomposite components shall be evaluated by component manufacturers to determine characteristics for quality control.

PART 3 EXECUTION

3.01 EXAMINATION

A. Conformance Testing:

1. CQAC shall collect samples, no less than one per 100,000 ft² of geocomposite to be installed for conformance testing. Testing shall include:
 - a. Mass per unit area.
 - b. Geotextile-Geonet peel adhesion.

3.02 INSTALLATION

A. Geocomposite Deployment:

1. On slopes, anchor geocomposite securely and deploy geocomposite down slope in controlled manner to continually keep geocomposite in tension.
2. Weight geocomposite with sandbags or equivalent in presence of wind. Do not remove weight until replaced with cover material.

3. Cut geocomposite with cutter (hook blade). Protect adjacent materials from potential damage due to cutting of geocomposite.
4. Prevent damage to underlying layers during placement of geocomposite.
5. During deployment, care shall be taken not to entrap in or beneath geocomposite, stones, dirt, excessive dust, or moisture that could damage geomembrane, cause clogging of geonet, or hamper subsequent seaming.
6. If dirt or excess dust is entrapped in geonet of geocomposite, it shall be washed clean prior to placement of next layer of material.
7. Geocomposite shall not be welded to geomembrane unless specified on Drawings.
8. Visually examine entire geocomposite surface before seaming for potentially harmful foreign objects such as stones/woodchips. Remove foreign objects encountered or replace geocomposite.

B. Geonet Seams and Overlap Procedures:

1. Overlap adjacent geonet roll edges minimum of 3-4 in. (75-100 mm). Overlap adjacent geonet roll ends minimum of 6-8 in. (150-200 mm).
2. Tie geonet overlaps with plastic fasteners. Use white or yellow tying devices for easy inspection. Do not use metallic devices.
3. Tie every 5 ft (1.5 m) along edges and, every 6 in. (0.15 m) in anchor trench, and along end-to-end seams.
4. In general, no horizontal seams are allowed on side slopes.
5. In corners of side slopes of rectangular landfills, where overlaps between perpendicular geonet strips required, unroll extra layer of geonet along slope, on top of previously installed geonets, from top to bottom of slope.
6. Stagger joints when more than 1 layer of geonet is installed.

C. Geotextile Seaming Procedures:

1. In general, no horizontal seams or splices allowed on side slopes except as part of patch. Splice is defined as seam connecting ends of 2 rolls.
2. Overlap geotextile minimum of 3 in. (75 mm) prior to seaming.
3. On slopes steeper than 10:1 (horizontal:vertical), continuously sew geotextiles. Spot sewing is not allowed.
4. On slopes shallower than 10:1 (horizontal:vertical), seam geotextiles as specified or thermally bond with written approval of GEOSYNTHETIC QAC.
5. Allow no earth cover material to be present beneath geotextile.
6. When sewing, use polymeric thread with chemical and ultraviolet light resistance properties equal to or exceeding those of geotextile.
7. Use locking stitch.

3.03 FIELD REPAIR PROCEDURES

A. Defects and Repairs: Repair small defects smaller than 3 ft by 3 ft (1 m by 1 m) as follows, if geonet is damaged.

1. Remove damaged geotextile.
2. Cut patch of new geotextile to provide minimum 12 in. overlap.
3. Thermally bond geonet patch to existing geocomposite.

B. If geonet is damaged:

1. Remove damaged geonet.
2. Cut patch of new material.
3. Secure patch to original geonet by tying every 6-in (0.15 m). Use tying devices specified.
4. Place geotextile patch overlapping damaged area by minimum of 12 in.
5. Thermally bond geotextile patch to existing geocomposite.

- C. Replace geocomposite if defect is determined to be large 3 ft by 3 ft (1 m by 1 m).

3.04 INTERFACE WITH OTHER PRODUCTS

- A. Following shall occur when deploying soil materials located on top of geocomposite.
 - 1. Geocomposite and underlying lining materials are not damaged.
 - 2. Minimal slippage of geocomposite on underlying layers occurs.
 - 3. No excess tensile stresses occur in geocomposite.
- B. Single-sided geocomposites shall not have soil placed in direct contact with geonet.

* * * END OF SECTION * * *

**SECTION 02433
PASSIVE GAS VENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES:

- A. Excavation of shallow trench.
- B. Field measurements/observations during installation.
- C. Laboratory testing of materials.
- D. Pipe installation.
- E. Cleanup.

1.02 PAYMENT FOR VENT CONSTRUCTION:

- A. Payment for Work under this section shall be made in accordance with unit price schedule in Bid Form. Payment shall be per vent.

PART 2 PRODUCTS

2.01 PIPE

- A. Well Pipe: 4-in. dia non-perforated Schedule 80 PVC.
- B. Well Screen: 4-in. dia perforated Schedule 80 PVC pipe with end slip caps. Drill holes per dimensions shown on Drawings.
- C. Fittings: 4-in. dia. PVC tee.

2.02 AGGREGATE

- A. Gravel:

Size (inches)	% Passing Sieve
1-1/2	100
1	60 - 90
3/4	20 - 55
1/2	0 - 10
3/8	0 - 5

- B. General backfill material shall consist of clean aggregate.

2.03 BENTONITE

A. Manufacturers:

1. Baroid.
2. American Colloid.
3. Or equal.

- B. Bentonite Powdered: Add powdered bentonite to soil around gas vent pipe in bore holes as shown on Drawing 4.14.

2.04 ROTARY VENTILATOR

- A. Galvanized steel wind-driven Rotary-Turbin ventilators.

- B. Manufacturers: McMaster-Carr, 1992 K11 or equal.

PART 3 EXECUTION

3.01 PREPARATION

- A. CONTRACTOR shall survey installation locations prior to beginning Work.

- B. Adjust location where excavation into CD&D waste is possible.

3.02 SPOILS DISPOSAL

- A. Excavated Refuse Disposal:

1. On-Site: Dispose of excavated spoils on-site, at location designated by OWNER.

3.03 INSTALLATION

- A. Solvent weld pipe sections.

- B. Install vent piping as single continuous unit and minimize flexural stress to unit.

- C. Perforated Section Backfill: Backfill with gravel shown on Drawing.

- D. Bentonite Seal: Use powdered bentonite mixed with cohesive soil material and hand tamp around vent pipe.

- E. Install geomembrane pipe boot around vent pipe, seal to pipe with stainless steel clamp and weld to geomembrane per Section 02406.

3.04 LABORATORY TESTING

- A. Gravel Backfill Materials: Perform minimum of one (1) laboratory grain size distribution tests on representative sample of gravel back material.

- B. CONTRACTOR responsible for laboratory testing, unless otherwise specified.

3.05 CLEANUP

- A. Dispose of debris and spoils resulting from excavating operations at OWNER'S specified on-site disposal area.

- B. Repair ruts in landfill cover, caused by CONTRACTOR'S equipment to condition and density equal to or exceeding that which existed prior to construction.

* * * END OF SECTION * * *

SECTION 02434
GAS MONITORING PROBES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Drill soil borings.
2. Soil sampling.
3. Visual classification of soil types.
4. Gas monitoring probe installation.

1.02 SUBMITTALS

A. Product Data:

1. Grain size curve of filter pack and fine sand filter pack seal.
2. Submit 5 days prior to drilling.

B. Miscellaneous:

1. Final Boring Logs.
 - a. Prepare final boring logs and probe construction details based on field information.
 - b. Submit 1 copy to ENGINEER within 10 working days after each boring complete.
2. Gas Monitoring Probe Construction Diagrams:
 - a. Submit 1 copy to ENGINEER within 10 working days after drilling complete.

C. Submit in accordance with Section 01340.

1.03 QUALITY ASSURANCE

- A. OWNER will provide geologist, geotechnical engineer or other professional experienced in soil boring, sample logging, and installation of gas monitoring probes. Individual shall be responsible for supervising and documenting information related to soil-intrusive activities.
- B. Prior to use, inspect well materials for cleanliness, deformations, and imperfections, and to ensure conformance with Specifications. Do not use defective materials.

PART 2 PRODUCTS

2.01 GAS MONITORING PROBES

- A. PVC: ASTM D1785 with one of the following cell classifications: 12454-B, 12454-C, 11443-B, 14333-D, 13233, or 15223-B.
- B. Riser:
 - 1. Gas Monitoring Probe Pipe.
 - a. Construct of nominal 1 in. ID (0.9 in. minimum dia), Schedule 40 flush-threaded O-ring or equivalent PVC pipe.
- C. Screen:
 - 1. Perforated PVC: 1/18 in. dia holes 180° apart with 1 in. spacing and alternate holes offset 90°.
- D. Joints:
 - 1. Threaded O-ring, do not glue.
- E. Caps:
 - 1. Top Cap: PVC, threaded or slip cap with valved hose barbed connector.
 - 2. Bottom: PVC, threaded with 1/4 in. bottom hole..

2.02 WATER

- A. Water used for drilling, bentonite hydration or concrete mixtures shall be free of bacterial or chemical contamination.
- B. Record water source location and volumes used on well installation form or soil boring log.
- C. Water source may be subject to water quality analysis by OWNER prior to use.

2.03 CONCRETE GROUT

- A. Cement: ASTM C150, Type I, air-entrained.
- B. Aggregate: ASTM C33.
- C. Concrete Mix: Measure and combine cement, aggregates, and water complying with ASTM C85.
- D. Ready-Mixed Concrete: ASTM C94.

2.04 BENTONITE

- A. General: Clay consisting of greater than 85% sodium montmorillonite, without additives.
- B. Powdered: 200 mesh.
- C. Granules: 8 mesh.

2.05 WELL SCREEN BACKFILL

A. Screen Filter Pack:

1. Well-sorted, well-rounded, silica based (95% minimum silica) gravel, visibly free of dust clay, mica, and organic matter.
 - a. Pea gravel.
 - b. Uniformity coefficient greater than or equal to 2.5.
 - c. Specific gravity equal to or greater than 2.5.

2.06 WELL HEAD PROTECTION

A. Protective Casing:

1. 6 in. dia.
2. 2 ft stick up above ground.
3. Locking hinged removable covers.
4. Steel.
5. Keyed alike master locks.
6. Drain hole, 1/4 in. dia.

B. Guard Posts:

1. Steel cement-filled Steel guard posts.
2. 3 ft length.
3. 4 in. dia.
4. 2-3 guard posts per well.

PART 3 EXECUTION

3.01 FIELD PREPARATION

- A. Clear and grub drilling locations in accordance with Section 02100. Install surface water and sediment control measures, if necessary.
- B. Construct access roads as necessary to drilling location.
- C. Construct necessary drilling pads.
- D. Drilling location may be adjusted in field with ENGINEER'S written approval.

3.02 GENERAL

- A. Perform auger borings in accordance with ASTM D1452.
- B. Unless otherwise stipulated, perform sampling in accordance with ASTM D1586.
- C. Take protective measures to prevent open boreholes from acting as safety hazard or conduit for contamination.

3.03 DRILLING

- A. Drilling and sampling test methods shall be in accordance with ASTM D420.
- B. Record measurements to nearest 0.1 ft.
- C. Record static water level during drilling and sampling, after completion of drilling and sampling and 24 hrs after hole drilled.
- D. Classify soil types using USCS classification system in accordance with ASTM D2488.
- E. Drill and sample to 20-ft depth with use of 4-in. minimum ID hollow stem augers or tricone roller bit and temporary steel casing. Do not use drilling fluids other than water unless agreed upon by ENGINEER. Notify ENGINEER prior to use of drilling fluids other than water.
- F. Boring Abandonment:
 - 1. If unable to install probe in boring abandon as follows:
 - a. Backfill borings with drill cuttings and native soils compacted to prevent settlement.
 - b. Approximately 24 hrs after abandonment, check grout for settlement. If settlement occurred, place additional grout to create slightly mounded condition.

3.04 GAS MONITORING PROBE INSTALLATION

- A. General:
 - 1. Refer to gas monitoring probe detail shown on Drawing 4.14.
 - 2. Steam clean gas monitoring probe screen, riser, end plug, centering guides immediately prior to monitoring well installation.
 - 3. Store gas monitoring probe construction materials in secure area removed from potentially contaminated areas adversely affecting performance of gas probe to produce representative samples.
 - 4. Record daily usage of well construction materials.
 - 5. In fine grained soils, ENGINEER shall bail standing water from boring prior to well installation.
 - 6. If gas monitoring probe installation is not possible, refer to Paragraph 3.03.F for borehole abandonment.
- B. Gas Monitoring Probe Screen Backfill:
 - 1. Backfill with screen filter pack and fine sand seal placed by gravity.
 - 2. Extend screen filter pack 2 ft above screen.
 - 3. Extend screen filter pack 6 in. beneath gas monitoring probe screen.
 - 4. Extend fine sand seal 1 ft above pea gravel.
 - 5. Calculate volume of annular space to be backfilled and compare to actual volumes used.
 - 6. Measure depth to sand pack and filter pack by direct method.
 - 7. Place centering guides as instructed by ENGINEER.
- C. Bentonite Seal:
 - 1. Use granular bentonite for seal material in gas monitoring probe.
 - 2. Hydrate seals minimum 12 hrs before placement of overlying grout or concrete cap.
 - 3. Seals shall be minimum 2 ft thick in gas probe.
 - 4. Measure depth to seal to nearest 0.1 ft.

D. Protective Pipe:

1. Place 2 ft minimum length, protective pipe over well stick-up with hinged, locking covers. PVC cap with hose barbed connector into PVC Riser Pipe.
2. Allow 4 in. space between top of PVC riser pipe and cover to protective pipe.
3. Label gas monitoring probe number on inside cover and outside of protective casing. Use nonfading permanent marker. Label in accordance with ENGINEER'S numbering system.
4. Provide keyed alike locks and keys for protective casing.

3.05 CLEANING

- A. Level piles of earth resulting from drilling or other operations.
- B. Clean site of debris resulting from Work.

* * * END OF SECTION * * *

**SECTION 02511
CRUSHED STONE PAVING**

PART 1 GENERAL

1.01 WORK INCLUDES

- A. Compacted crushed aggregate paving (surface) course over road geotextile for on-site access roads and for road surface restoration at pipe crossings.

1.02 RELATED SECTIONS

- A. Section 02415 - Geotextile

1.03 REFERENCES

- A. ASTM C136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ASTM D689 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.

1.04 JOB CONDITIONS

A. Weather Limitations

1. Do not place road geotextile or crushed aggregate on frozen subgrade or subgrade covered with ice or snow.
2. Do not place road geotextile or crushed aggregate on excessively wet subgrade.
3. Do not place road geotextile or crushed aggregate on dry and dusty subgrade. An excessively dry subgrade shall be watered, and shall be reworked or recompact, if necessary.

1.05 SUBMITTALS

- A. Test results confirming that the access road crushed aggregate meets the material specifications in Part 2.
- B. Submit in Accordance with Section 01340.

PART 2 PRODUCTS

2.01 CRUSHED AGGREGATE

- A. Crushed aggregate material shall meet a gradation similar to AASHTO No: 5 provided below:

SIEVE SIZE (inches)	AMOUNTS FINER THAN EACH SIEVE, BY WEIGHT
1-1/2	100
1	90 to 100
3/4	20 to 55
1/2	0 to 10
3/8	0 to 5

- B. The aggregate shall consist of hard, durable particles of crushed stone or crushed gravel and a filler of natural sand, stone sand, or other finely divided mineral matter. The composite material shall be substantially free from vegetable matter, shale, and lumps or balls of clay.

2.02 ROAD GEOTEXTILE

- A. Provide a 16 oz/sy woven or nonwoven product comprised of polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. Geotextile shall be insect, rodent, mildew, and rot resistant.
- B. Reference Section 02415 for further specifics on the geotextile material.
- C. Geotextile shall be free of defects, rips, holes or flaws.

PART 3 EXECUTION

3.01 LINES AND GRADE

- A. The lines, grades, and cross section shall be constructed as shown on the drawings or as directed by the ENGINEER.

3.02 EQUIPMENT

- A. The weight, type, capacity, and method of operation of all hauling, spreading, and compaction equipment shall be such that no damage will result to the subgrade, geotextile, or aggregate in place. Spreading equipment shall not damage geotextile or significantly segregate the aggregate.
- B. Motor graders or bulldozers can be used for shaping subgrade and crushed aggregate surface course. They shall have the weight, rigidity, and be suitable for the work.

3.03 SURFACE PREPARATION

- A. Proofroll subgrade with loaded dump truck, scraper or other suitable roller equipment. Remove and replace any soft or spongy spots, where displacement in subgrade is more than 1/2 inch in front of rollers.
- B. Fill any ruts or depressions, grade off bumps and irregularities to obtain smooth, even bed.
- C. Grade subgrade finished surface for positive drainage.

3.04 EXAMINATION

- A. Confirm that the compacted subgrade is firm and ready to receive work of this Section by visual observation by ENGINEER during proofrolling.
- B. Confirm that gradients and elevations of subgrade are correct.
- C. Authorization to install means acceptance of existing and prepared conditions.

3.05 ROAD GEOTEXTILE PLACEMENT AND HANDLING

- A. CONTRACTOR shall handle all geotextiles in such a manner as to ensure they are not damaged in any way.
- B. Geotextile shall be completely covered with a minimum 12-in. thick layer of crushed aggregate within 48 hours of removing protective wrapping from geotextile.
- C. Adjacent sections of geotextile shall be sewn or overlapped. A Type 401 stitch shall be used for sewing. Overlapped joints shall be placed with a minimum overlap of 2 ft.
- D. Any holes or tears in geotextile shall be repaired with a patch of the same geotextile material extending a minimum of 3 ft from the edge of defect in all directions.
- E. CONTRACTOR shall place crushed aggregate over geotextile in such a manner as to ensure:
 - 1. No damage to geotextile
 - 2. Minimal slippage of geotextiles on underlying subgrade.
 - 3. No excess tensile stresses in geotextile.
- F. No turning movements for any hauling or spreading equipment shall be allowed over geotextile until the total depth of crushed aggregate has been placed and compacted.

3.06 PLACING CRUSHED AGGREGATE PAVING

- A. Spread crushed aggregate over road geotextile to a total compacted thickness as indicated on the drawings.
- B. Level surfaces to elevation and gradients indicated.

* * * END OF SECTION * * *

SECTION 02605
MANHOLES, VAULTS, AND INLETS

PART 1 GENERAL

1.01 SUMMARY

As used in this specification, manhole includes manholes and vaults.

A. Section Includes:

1. Cast-in-place concrete, concrete block or precast concrete manholes and inlets as shown on Drawings.
2. Where materials of construction are not shown on Drawings, CONTRACTOR has option of selecting one of three materials of construction.

1.02 SUBMITTALS

- A. Include one copy of results of tests and certification reports with each shipment of materials.
- B. If manufacturer's test data is inadequate or unavailable, ENGINEER reserves right to require cores drilled for compressive strength tests.
- C. Submit in accordance with Section 01340.

PART 2 MATERIALS

2.01 PRECAST REINFORCED CONCRETE MANHOLES AND INLETS.

- A. ASTM C478.
- B. Provide eccentric or concentric cone type precast tops as shown on Drawings. Flat top slabs shall be used only with approval of ENGINEER.
- C. Reinforced integral base shall be as shown on Drawings.
- D. Incorporate cast-in adapters, boots, to accommodate connection of pipe, provide for sewer grade differential between center of manhole and manhole wall for each sewer pipe entering manhole.
- E. Wall Thickness:

Manhole Diameter	Wall Thickness
3 ft-6 in.	4-1/2 in.
4 ft-0 in.	5 in.
5 ft-0 in.	6 in.
6 ft-0 in.	7 in.

- F. Joint precast sections of storm sewer manholes and inlets with preformed flexible plastic gaskets or rubber type gaskets.
- G. Joint precast sections of sanitary sewer manholes with rubber gaskets or preformed flexible plastic gaskets.
- H. Flexible Plastic Gaskets:
 - 1. Manufacturers:
 - a. Ram-Nek, manufactured by K.T. Snyder Company, Inc.
 - b. Kent Seal, manufactured by Hamilton-Kent, Inc.
 - c. Or equal.
 - 2. Comply with physical requirements for Type B gaskets in AASHTO M198.
- I. Rubber Gaskets: ASTM C443.
- J. Manufacturer shall install steps as specified herein. Embed steps into riser or conical top section wall minimum of 3 in.
- K. Mark each precast section with name or trademark of manufacturer and date of manufacture. Marking shall be indented into manhole section or shall be painted thereon with waterproof paint.
- L. Source Quality Control:
 - 1. Precast Reinforced Concrete Manhole Testing:
 - a. Test risers and tops in accordance with ASTM C497 for compressive strength compliance by compression tests on cores drilled from 5% of lot.
 - b. Number of compression tests may be reduced to 1% of lot, with minimum of two cores per lot, for manhole sections fabricated on sewer pipe machine.
 - c. OWNER will approve testing laboratory.
 - d. Manufacturer's core drilling machine shall conform to ASTM C497. Operator shall take test cores as directed by testing laboratory.
 - e. Stamp risers and tops, meeting strength requirements, with appropriate monogram.

2.04 MANHOLE STEPS

- A. Provide one of following.
 - 1. Steel Reinforced Plastic:
 - a. Approved plastic such as copolymer polypropylene meeting with requirements of ASTM D4101, Type II, Grade 49108, reinforced with deformed 3/8 in. dia reinforcing bar which conforms to requirements of ASTM A615, Grade 60.
 - 2. Gray Cast Iron:
 - a. Conforming to requirements of ASTM A48, Class 30B, and have minimum cross-sectional dimension of 1 in. in any direction.
 - 3. Ductile iron.

- B. Embedded portion of steps shall be deformed and grouted to withstand specified live loading.

2.05 LIDS AND CASTINGS

A. Manufacturers:

1. Neenah Foundry.
2. Campbell Foundry.
3. Or equal.

B. Castings:

1. Anchored Manhole: Neenah R-1916-C with four 1-in. bolt holes, Type F lid with concealed pickhole.
2. Sanitary Manhole: Neenah R-1500 with machined bearing surface, Type B self sealing with concealed pick hole.
 - a. Provide with bituminous sealing material, approved by ENGINEER, which effects watertight seal between frame and manhole.

2.06 ACCESS HATCH

A. Prefabricated Drainage Channel Type:

1. Manufacturers:

- a. Bilco Type J-4AL.
- b. Or OWNER approved equal.

2. Door leaves shall be 1/4 in. diamond pattern plate with reinforcing on underside to withstand AASHTO HS-20 wheel loading.
3. Drainage channel frame shall be 1/4 in. with full anchor flange around perimeter.
4. Equip doors with heavy stainless steel hinges with stainless steel pins. Hinges shall be through bolted to cover and frame with stainless steel bolts.
5. Equip doors with fully enclosed compression springs and hold-open arm with positive locking device with conveniently positioned release handle for easy and controlled closing.
6. Provide stainless steel snap lock-mounted on bottom of leaf with removable topside handle and socket recessed in cover.
7. Hardware shall be Type 304 stainless steel.
8. Provide 1-1/2-in. drainage coupling.
9. Factory finish on aluminum surfaces shall be anodized with coal tar epoxy coating applied to surfaces in contact with concrete.
10. Manufacturer shall warranty in writing against defects in material or workmanship for 5 years.

2.07 FLEXIBLE SEAL

A. Physical Requirements: ASTM C443.

B. Performance Requirements: both ASTM C425 and C443.

2.08 CEMENT MORTAR

A. ASTM C270, Type M.

PART 3 EXECUTION

3.01 EXCAVATION AND PREPARATION OF SUBGRADE

- A. Excavate and prepare subgrade in accordance with Section 02221 and Drawings.
- B. Elevations indicated on Drawings designate sewer elevations at location of center of manholes.

3.02 BASES

- A. Cast-in-Place Base for Precast Manhole:
 - 1. Set precast manhole bottom barrel section on concrete brick or solid block so bottom of section is below spring line of outlet pipe and plumbed.
 - 2. Pour in accordance with above.
- B. Precast Manhole with Integral Base:
 - 1. Excavate deep enough so bottom manhole barrel section with integral base rests on 4 in. minimum of bedding material.

3.03 BACKFILL

- A. Backfill with pipe bedding and cover material to spring line of incoming pipe in accordance with Section 02221.

3.04 MANHOLE INVERT

- A. Do not pour until manhole is built and backfilled.
- B. Invert shall be same diameter as larger of adjoining sewers and shall be shaped as shown on Drawings.

3.05 PIPE TO MANHOLE CONNECTION

- A. Fill space between pipe and precast manhole wall with brick mortared in place, except approved flexible watertight pipe to manhole seal is required for flexible sanitary sewer connections.
- B. Nonflexible Connections of Rigid Pipe:
 - 1. When connected to concrete brick, block or precast manhole, support as indicated in Article 3.02.
 - 2. Support pipe entering manhole above manhole base from wall of manhole back to face of first pipe joint bell with wall of backfill concrete, brick or solid concrete block columns.
 - 3. Brick or concrete connecting pipe into manhole wall.
- C. Nonflexible Connection of Plastic Pipe:
 - 1. Connections to concrete brick, block or monolithic manholes without use of flexible seal, require use of approved manhole waterstop.
 - 2. Position waterstop within wall of manhole and attached to pipe according to manufacturer's instructions prior to pouring concrete base.
 - 3. Keep concrete bricks or blocks used to support pipe outside of waterstops and do not place within manhole perimeter.
 - 4. Care shall be taken to properly work concrete to ensure maximum contact with these waterstops.

D. Flexible Connection of Pipe:

1. Connect plastic sanitary sewer pipe to precast manholes by means of flexible watertight pipe to manhole seal.
2. Lay pipe entering manhole through this seal in accordance with Section 02221 and do not rigidly support.
3. To maintain seal flexibility, plug portion of annular space between pipe and manhole wall which falls within area of poured invert with flexible plastic gasket prior to pouring manhole invert.

3.06 SETTING OF PRECAST REINFORCED CONCRETE MANHOLES

- A. Set manholes plumb with orientation of cast-in items as shown on Drawings.
- B. Joint precast sections of storm sewer manholes and inlets with preformed flexible plastic gaskets or rubber type gaskets.
- C. Joint precast sections of sanitary sewer manholes with rubber gaskets or preformed flexible plastic gaskets.

3.07 MANHOLE STEPS

- A. Equally space vertically to form continuous ladder at distance of 16 in. oc.
- B. Place steps within allowable tolerance of ± 1 in.

3.08 SETTING CASTINGS

- A. Set at elevation shown on Drawings.
- B. Sealing:
 1. Standard Manhole (Sanitary): Bituminous sealing material, approved by ENGINEER, which effects watertight seal between frame and manhole.
 2. Sealed Manhole (Sanitary):
 - a. Joint: Mortar or mortar and external elastomeric seal.
 3. Anchored Manhole (Sanitary):
 - a. Joint: Bolted down frame and cover with mortar and butyl rubber seal.

3.09 FIELD QUALITY CONTROL

- A. Precast reinforced concrete risers and tops shall be subject to rejection on account of failure to conform to any specification requirements. In addition, individual sections of risers and tops may be rejected because of any of following reasons:
 1. Fractures or cracks passing through shell, except for single end crack not exceeding depth of joint.
 2. Defects indicating imperfect proportioning, mixing, and molding.
 3. Surface defects indicating honeycombed or open texture.
 4. Damaged ends where such damage would prevent making satisfactory joint.
 5. Manhole steps out of line, or not properly spaced.
 6. Infiltration into sanitary sewer exceeding 0.0758 gal/vert ft/hr.

7. Internal dia of section varying more than 1% from nominal dia.
8. Any continuous crack having surface width of 0.01 in. or more and extending for length of 12 in. or more, regardless of position.

* * * END OF SECTION * * *

**SECTION 02732
FORCE MAIN SYSTEMS**

PART 1 GENERAL

1.01 SUMMARY

A. Measurement and Payment:

1. Comply with Section 01025.

1.02 SUBMITTALS

A. Product Data:

1. PVC pipe and fitting certification.
2. HDPE pipe and fitting certification.

B. Submit in accordance with Section 01340.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

- A. Install pipe, fittings, and specials in accordance with recognized industry practices achieving permanently leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum of joints. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections.**

B. Polyvinyl Chloride (PVC) Pipe: Refer to Section 15078.

C. High Density Polyethylene (HDPE) Pipe: Refer to Section 15079.

2.02 MANHOLES

- A. Comply with Section 02605.**

2.03 COMBINATION AIR RELEASE/VACUUM VALVE

A. Manufacturers:

1. APCO, Model 443.
2. Or equal.

B. Operating pressure up to 150 psi.

- C. Adaptable for use with sewage and groundwater at Skinner site, and capable of releasing sewage gas or air when pump(s) operating and capable of permitting air to enter main following pump shutdown.**

D. Equip with 1-in. inlet, 1-in. blowoff, center quick disconnect coupling, and 1/2 in. shutoff valve and quick disconnect for backflushing.

- E. Cast iron body and cover with stainless steel float. Materials of construction shall be resistant to exposure to sewage and groundwater at Skinner site.

PART 3 EXECUTION

3.01 INSTALLATION OF FORCE MAIN

- A. Install HDPE pipe in accordance with Section 15079 and PVC pipe in accordance with Section 15078.
- B. PVC Casing Pipe: Support and brace inserted pipe to prevent shifting or flotation during backfilling operations.
- C. Strapping, Lugged Pipe and Fittings: Refer to Section 15078 and Section 15079.

3.02 AIR RELEASE/VACUUM MANHOLE

- A. Install manhole, including air release/vacuum valve, in accordance with detail included on Drawings.

3.03 FIELD QUALITY CONTROL

- A. Test for pressure and leakage in accordance with Section 01669.

* * * END OF SECTION * * *

SECTION 02750
DECONTAMINATION PAD

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Supply, installation, operation, removal, and disposal of decontamination pad including:
 - 1. PVC Geomembrane Liner
 - 2. Coarse Aggregate
 - 3. Geotextile Filter
 - 4. CSP Riser with grate.
 - 5. Sump pump with power source, contractor owned.
 - 6. Waterproof Cover, for inactive periods

1.02 RELATED SECTIONS

- A. Section 02224 - Excavation, Backfilling, and Compaction.

1.03 UNIT PRICES

- A. Basis of Measurement: On a lump sum basis.
- B. Basis of Payment: Includes supplying materials, installation, operation, removal, and disposal of decontamination pad.
- C. Performing decontamination of equipment shall be incidental to the site work and include decon water, cleaning, pumping water from sump, decon pad maintenance.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer:
 - a. Manufacturer shall have at least 5 years continuous experience in manufacture of PVC geomembrane rolls and/or experience totaling 2,000,000 sf of manufactured rolls for at least 10 completed facilities.
 - 2. Fabricator (if applicable):
 - a. Fabricator shall have at least 5 years continuous experience in fabrication of PVC liners or covers and/or experience totaling 2,000,000 sf of fabricated PVC geomembrane liners or covers for at least 10 completed facilities.

PART 2 PRODUCTS

2.01 PVC GEOMEMBRANE LINER AND WATERPROOF COVER

- A. PVC Geomembrane shall:
 - 1. Be manufactured of new first-quality polyvinyl chloride (PVC).

2. Be designed and manufactured specifically for the intended purpose.
3. Be free from reclaimed polymer, unless polymer is recycled during manufacturing process with appropriate cleanliness, and if recycled polymer does not exceed 2% by weight.
4. Have the following values:

PVC GEOMEMBRANE PROPERTIES

Property	Qualifier	Unit	Specified Value	Test Method
Thickness	nominal minimum	mils	40 38	ASTM D1593
Tensile Properties (each direction):				ASTM D882
1. Breaking factor	minimum	lb/in. width	92	
2. Modulus at 100% elongation	minimum	lb/in. width	36	
3. Elongation at break	minimum	%	300	
Tear Resistance	minimum	lb	10	ASTM D1004
Low Temperature	maximum	°F	-20	ASTM D1790
Dimensional Stability (each direction)	max. change	%	5	ASTM D1204 212°F, 15 min.
Water Extraction	max. loss	%	-0.35	ASTM D3083 (as modified in NSF Annex A)
Volatile Loss	max. loss	%	0.5	ASTM D1203
Bonded Seam Strength	minimum	lb/in. width	70	ASTM D3083 (as modified in NSF Annex A)
Peel Adhesion	minimum	lb/in.	10	ASTM D413 (as modified in NSF Annex A)

B. In addition, geomembrane shall:

1. Consist of unreinforced PVC containing 1% weight maximum additives, fillers, or extenders.
2. Be produced so as to be uniform in color, thickness, size, and surface texture and shall be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter.

C. Panel:

1. Supply geomembrane as one panel. Panel is to measure 50 ft by 40 ft and to be fabricated in the factory.

D. Fabricated Seams:

1. Approved processes for seaming are chemical or thermal welding.
2. Proposed alternate processes shall be documented and submitted to ENGINEER for approval.

2.02 GEOTEXTILE FILTER

- A. Supply a nonwoven polyester or polypropylene geotextile for which the "minimum average roll values" meet or exceed the following values:

GEOTEXTILE PROPERTIES

Property	Qualifier	Unit	Specified Value	Test Method
Grab Strength	Min.	lb	270	ASTM D4632
Puncture Strength	Min.	lb	80	ASTM D4833
Mullen Burst Strength	Min.	psi	430	ASTM D3786
Trapezoidal Tear	Min.	psi	75	ASTM D4533
Apparent Opening Size	Min.	U.S. Standard Sieve No.	50	ASTM D4751
Permittivity	Min.	1/sec.	0.5	ASTM D4491

2.03 CSP RISER

- A. CSP riser shall conform to AASHTO specifications, and be 14 gauge material.

2.04 NEENAH GRATE SET

- A. Grate casting shall be Neenah R2549 grate and bolt on frame.

2.05 CONCRETE BASE

- A. Concrete: ASTM C94: normal Portland Cement; 2500 psi at 28 days.

2.06 COARSE AGGREGATE

- A. Coarse aggregate shall meet the following requirements:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1"	100%
3/8"	60-85%
No. 8	25-60%
Loss by Washing	9-16%

2.07 SUMP PUMP AND PIPE/HOSE

- A. Pump shall be capable of dewatering the riser and discharging in the sump at 30 gpm. CONTRACTOR shall provide power to operate the sump pump either by generator or temporary electrical hook-up.
- B. Pipe or hose from sump pump to tank shall fit the sump pump, be tight and not leak, and be of sufficient quantity to reach the tank.
- C. Sump shall be capable of capturing decontamination pad runoff and draining the runoff through pipe to a tank designated for decontamination pad water.

2.08 CAST IN PLACE CONCRETE

- A. Concrete to have:
 - 1. Minimum 28 day compressive strength of 4000 psi.
 - 2. Minimum 6 bags of cement per cubic yards.
 - 3. Maximum slump of 4 inches.
 - 4. Air Entraining Admixtures, ASTM C260, concrete shall contain 4% to 6% air by volume.
 - 5. Mixing water to be potable.
 - 6. Aggregates: Fine to be natural sand, Coarse to be crushed gravel ASTM C33 size 67 (3/4" max.).
- B. Cement shall be Portland Cement conforming to ASTM C150, Type 1 except tricalcium aluminate content shall be less than 8%.
- C. Reinforcement:
 - 1. ASTM A615 Grade 60.

PART 3 EXECUTION

3.01 EXCAVATION

- A. Excavate decontamination pad and sump in the location and to the grades shown on the drawings.
- B. Excavation shall occur according to Section 02224 - Excavation, Backfilling, and Compaction.
- C. Excavation shall be cleared of all rocks, debris, and roots that could puncture or otherwise damage the geomembrane.

3.02 GEOMEMBRANE LINER PLACEMENT

- A. Weather Conditions:
 - 1. Do not place panel at ambient temperature below 32°F without performing proper procedures recommended by Manufacturer.
 - 2. Do not place during precipitation, in presence of excessive moisture (e.g., fog, dew), in area of ponded water, or during excessive winds.
- B. Placement:
 - 1. Equipment used shall not damage geomembrane by handling, trafficking, leakage of hydrocarbons (such as gasoline or oil), or other means.

2. Personnel working on geomembrane shall not smoke, wear damaging shoes, or engage in other activities which could damage geomembrane.
3. Methods used to unroll panel shall not cause scratches or crimps in geomembrane and shall not damage supporting soil.
4. Method used to place panel shall minimize wrinkles.
5. Place adequate loading (e.g., sand bags, tires) not likely to damage geomembrane, to prevent uplift by wind (in case of high wings, continuous loading is recommended along edges of panels to minimize risk of wind flow under panels).
6. Drape geomembrane over the side berms and into the anchor trench and backfill trench with soil.

C. Damage:

1. Any panel which, in judgement of OWNER or ENGINEER, becomes seriously damaged (such as torn or twisted permanently) shall be replaced at no cost to OWNER.

3.03 AGGREGATE, RISER, AND GEOTEXTILE PLACEMENT

- A. Wrap geotextile filter around CSP riser.
- B. Place CSP riser vertically into a 3 ft by 3 ft concrete pad which is set on a cushion of geotextile filter material in the low point of the sump.
- C. Place fine aggregate around CSP riser and fill excavation in one lift with fine aggregate to within 1 ft of final grade. Take care to not damage geomembrane. Do not drive directly on geomembrane.
- D. Grade top of fine aggregate to slope towards the CSP riser. Do not compact fine aggregate.
- E. Place geotextile filter on top of fine aggregate. Overlap a minimum of 2 ft between adjacent segments of geotextile.
- F. Place coarse aggregate on geotextile filter in one lift. Do not drive directly on geotextile. Take care to not damage geotextile.
- G. Mound coarse aggregate around riser.
- H. Compact coarse aggregate with a vibrating smooth drum roller.
- I. Place removable grate or riser.

3.04 SUMP PUMP

- A. Place sump pump in the bottom of the CSP riser and discharge to tank.

3.05 WATERPROOF COVER

- A. During all inactive period CONTRACTOR shall deploy waterproof cover over decontamination pad secured by sandbags every 3 ft around the perimeter.
- B. During a decontamination pad use CONTRACTOR shall carefully rollup and store off to the side the waterproof cover.

3.06 CLOSURE OR REMOVAL

- A. Upon completion of site work CONTRACTOR shall dismantle the decontamination pad and dispose of in a licensed disposal facility approved by OWNER.
- B. The decontamination pad area shall be restored to original condition by spreading topsoil and reestablishing vegetation.

* * * END OF SECTION * * *

SECTION 02831
CHAINLINK FENCES AND GATES

PART 1 GENERAL

1.01 SUMMARY SCOPE

- A. Relocation of site security fence to allow for trench construction.
- B. Construction of final site security fence after landfill and trench construction.

1.02 DESIGN CRITERIA

- A. Fence height: 6'-0" plus 1 ft 45° barbed wire supporting arm.

1.03 SUBMITTALS

- A. Product Data:
 - 1. Fabric material.
 - 2. Framework material.
- B. Submit in accordance with Section 01340.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials with manufacturer's tags and labels intact and legible.
- B. Handle and store to avoid damage.

1.05 PROJECT/SITE CONDITIONS

- A. Perform preliminary grading of area where trench will be constructed prior to relocation of security fence.
- B. Do not install fence for final security fence alignment until final grading is complete and finish elevations are established.

PART 2 PRODUCTS

2.01 FABRIC

- A. Steel wire helically wound and interwoven to provide continuous mesh without knots or ties, conforming to requirements of ASTM A491.
- B. Mesh Size: 2 in.

C. Wire Size:

<u>Usage</u>	<u>Gauge</u>	<u>Dia</u>
Standard Industrial	9	0.148

D. Galvanized Coating: ASTM A392, Class 2.

E. Fabric Ties: Minimum 9 ga aluminum or zinc wire.

F. Selvages:

1. Fabrics with 2 or 2 1/8 in. (50 or 54 mm) mesh, in heights 60 in. (1,520 mm) and under shall be knuckled at both selvages. Fabric 72 in. (1,830 mm) high and over shall be knuckled at one selvaqe and twisted at other.
2. Selvages of fabrics with meshes of less than 2 in. (50 mm) shall be knuckled.

2.02 FRAMEWORK

A. Posts, Rails, and Braces :

1. Galvanized steel pipe conforming to ASTM A53, Schedule 40.
2. Roll form steel C-sections conforming to ASTM A570, Grade 45, galvanized in accordance with ASTM A123.

B. Dimensions and Weights:

<u>Use and Shape</u>	<u>Uncoated Minimum Outside Dimensions (in.)</u>	<u>Uncoated Minimum Weight (lbs/ft)</u>
End, Corner, and Pull Posts		
Height: 6 to 8 ft		
Round	2.875 o.d.	5.79
Roll Formed	3.50 x 3.50	4.85
Gate Posts		
Leaf Width 6 ft or Less		
Round	2.875 o.d.	5.79
Roll Formed	3.50 x 3.50	4.85
Leaf Width 13 ft or Less		
Round	4.00 o.d.	9.10
Leaf Width 18 ft or Less		
Round	6.625 o.d.	18.97
Leaf Width Over 18 ft		
Round	8.625 o.d.	28.55
Rails and Braces		
Round	1.66 o.d.	2.27
Roll Formed	1.625 x 1.25	1.35

Line Posts		
Round	2.50 o.d.	3.65
Roll Formed	1.875 x 1.625	2.28
Roll Formed Heavy Section	2.25 x 1.70	2.70

- C. Tension Wire: Spiraled or crimped No. 7 ga coated with 0.40 oz aluminum/sq ft.
- D. Framework color shall match chainlink fence color.

2.03 BARBED WIRE

- A. Double strand 12 1/2 ga steel wire with 14 ga, 4 point round steel barbs spaced approximately 5 in. on center.
- B. Galvanized in accordance with ASTM A121, Class III.

2.04 GATES

- A. Swing, Sliding type, complete with latches, stops, keepers, hinges, rollers and roller track, barbed wire supporting arms, and 3 strands barbed wire above fabric.
- B. Construct gates with top, bottom, and side framework of following dimensions and weights.

<u>Use and Shape</u>	<u>Minimum Outside Dimensions (in.)</u>	<u>Minimum Weight (lbs/ft)</u>
Height 6 ft or Less and Leaf 8 ft or Less		
Round	1.90 o.d.	2.72
Square	1.50	1.90
Height Over 6 ft or Leaf Width Over 8 ft		
Round	1.90 o.d.	2.72
Square	2.00	2.60

- C. Weld joints or assemble with fittings. Use 3/8 in. dia truss rods on gates assembled with fittings. Provide vertical bracing at 8 ft maximum spacing. Provide horizontal brace or 3/8 in. dia truss rod for leaves over 10 ft wide.
- D. Cover with fence fabric, attached securely to frame with fabric ties at 15 in. maximum spacing.
- E. Latch: Plunger bar type with integral padlock eye to permit operation from either side of gate.

2.05 TENSION BARS

- A. Minimum 3/16 in. by 3/4 in. galvanized steel bars.
- B. One bar for each end and gate post, and two for each corner and pull post.

2.06 HARDWARE AND FITTINGS

- A. Solid aluminum alloy/aluminum coated steel in compliance with ASTM F626 or hot dip galvanized in accordance with ASTM A153.
- B. Standard post tops provided with hole suitable for through passage of top rail with integral barbed wire supporting arm.

2.07 BARBED WIRE SUPPORTING ARMS

- A. Pressed steel, designed to carry 3 strands of barbed wire.
- B. Sufficient strength to carry 250 lb load applied at outer strand.
- C. Tilted at 45° angle, except vertical at gates.

2.08 FOOTINGS

- A. Class B2 concrete in accordance with Section 03300.

2.09 SIGNS

- A. Provide signs, 4 ft by 2 ft in size, constructed of 1/2 in. exterior plywood with 4 in. lettering with words "Danger, Keep Out, United States Environmental Protection Agency Superfund Site" for the landfill security fence. Signs for landfill will be at gate location and every 200 lineal feet of fence.
- B. Color of signs and lettering shall be black lettering on flat white background.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine conditions under which fence and gates to be installed. Notify ENGINEER in writing of improper Work conditions.
- B. Do not proceed with Work until unsatisfactory conditions corrected.
- C. Check location of underground work to make sure fence footings clear utilities and drainage work.

3.02 INSTALLATION

- A. Framing:
 - 1. Install line posts not more than 10 ft apart.
 - 2. Install pull posts not more than 600 ft apart where straight run of fence exceeds 600 ft and fence line changes direction by more than 15°, but less than 30°.
 - 3. Install corner posts where fence line changes direction by more than 30°.
 - 4. Set posts in concrete footings, plumb and true to line.
 - 5. If C-section line posts used, may be mechanically driven 3 ft 0 in. into ground in lieu of concrete set.
 - 6. Brace and truss end, pull, corner, and gate posts to adjacent line posts. Provide brace to match top rail spaced midway between top rail and tension wire and extending to adjacent line post. Truss diagonally with 5/16 in. dia tension rod with turnbuckle.
 - 7. Fasten top rail to end, pull, gate, and corner posts. Pass top rail through fittings of line posts.

8. Provide expansion and contraction joints in top rail for each 100 lin ft of fence.
9. Fasten bottom tension wire to end, pull, gate, corner, and line posts.

B. Footings:

1. Vertical sides to minimize uplift. Dispose of excavated material in accordance with Section 02220.
2. Rod and compact concrete around posts. Slope top of footings above level of adjacent grade and trowel finish.
3. Size:
 - a. 6 in. minimum dia, plus outside dimension of post.
 - b. Set corner, end, pull, and gate posts 42 in. into concrete.
 - c. Set line posts 36 in. into concrete.
 - d. Total depth of concrete 6 in. greater than required for post embedment.
4. Time of Set: 48 hrs before rails erected or fabric applied or stretched.

C. Fabric:

1. Place fabric on outside of posts and stretch to avoid bulging or buckling.
2. Fasten at line posts, top rail, and bottom tension wire with aluminum or zinc ties. Space ties not more than 15 in. apart on line posts and not more than 24 in. apart on rail and tension wire.
3. Fasten at terminal posts at intervals not exceeding 15 in. using flat or beveled galvanized steel bands with 5/16 in. by 1 1/4 in. galvanized carriage bolts and nuts.
4. Make tie connections on interior side of fence.

D. Gates:

1. Install gates plumb, level, and secure for full opening without interference.
2. Install ground-set items in concrete for anchorage.
3. Adjust hardware for smooth operation and lubricate where necessary.
4. Install gates according to manufacturer's instructions, plumb, level, and secure.

E. Signs:

1. Secure signs on fence at 200 ft maximum spacing and at gate locations.

F. Protective Electrical Ground.

1. Ground continuous fence at intervals not exceeding 500 ft. Ground within 100 ft of gates in each section of fence adjacent to gate.
2. Ground fence under power line by three grounds, one directly under crossing and one on each side 25 ft to 50 ft away. Locate single ground directly under each telephone wire or cable crossing.
3. Use counterpoise ground only where it is impossible to drive ground rod.
4. Connect ground wire to fabric and ground rod by mechanical clamp of cast bronze body and bronze or stainless steel bolts and washers.

3.03 ADJUSTMENT AND CLEANING

A. Paint:

1. Paint posts or other work cut on job with heavy coat of approved zinc-rich primer paint.
2. Paint abrasions or stripping of galvanizing on pipe, fittings or fabric as specified above.

B. Peen bolts located on lowest 72 in. of fencing.

C. Remove barricades and protection at Project completion.

* * * END OF SECTION * * *

SECTION 02930
TOPSOIL AND SEEDING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes placement of topsoil and seeding, fertilizing, and mulching by CONTRACTOR.

1.02 SUBMITTALS

- A. Test Results:

1. Copy of soils test results including fertilizer and lime requirements before seeding work begins.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:

1. Deliver fertilizer and seed to site in original, unopened containers bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark, and conformance to state law.
2. Fertilizer, seed, and mulch delivered to site shall be located on site as directed by OWNER.
3. Locate mulch on site where indicated by OWNER.

1.04 QUALITY ASSURANCE

- A. OWNER will perform construction quality assurance (CQA) as defined in Construction Assurance Plan (CQAP) for the installation of lining systems for Skinner Landfill Superfund Site, Butler County, Ohio.

1.05 METHOD OF MEASUREMENT AND PAYMENT

- A. OWNER will not provide topsoil from on-site and/or off-site sources.

CONTRACTOR should provide topsoil seeds, fertilizer, and mulch.

- B. The quantity of topsoil in-place completed and accepted in final work will be measured in cubic yards based on a record survey performed by a Professional Land Surveyor. The accepted quantities thus measured will be paid for at the contract unit prices per cubic yard.

Measurement of seeding shall be the number of square yards of the area seeded.

Measurement of fertilizer and mulch shall be the number of tons of fertilizer and mulch furnished and placed in accordance with these specifications.

1.06 GUARANTEE

- A. Guarantee seeded area for duration of 1 yr after seeding to be alive and in satisfactory growth at end of guarantee period.

1. For purpose of establishing acceptable standard, scattered bare spots, none larger than 1-sq ft will be allowed up to maximum of 3% seeded area.

PART 2 PRODUCTS

2.01 TOPSOIL

- A. Fertile friable loam containing liberal amount of humus from off-site sources or on-site topsoil material, neither excessively acid nor excessively alkaline, suitable for growth of grass and plants.
- B. Free from hard lumps, plants and their roots, gravel, cinders, stone over 1-1/2 in. in any dimension, weed seeds and quack grass roots, and other undesirable material.
- C. Topsoil Documentation:
 - 1. One sieve analysis for each source.
 - 2. One organic matter content, ASTM D2974, Method C.
 - 3. Nutrient requirements, N, P, and K and applicable micro-nutrients for proposed seed mixture.
- D. Topsoil removed and stockpiled during site grading may be used, provided it meets above requirements.

2.02 SEED

- A. General:
 - 1. Fresh, clean, and new crop seed included in following varieties and proportioned by weight.
 - 2. Weeds shall not exceed 0.25%.
 - 3. Refer to Surface Water Control Drawing.
- B. Seed Mix - Temporary:
 - 1. Annual Ryegrass: 100%: 1 lb/1000 sq. ft.
 - 2. Winter Rye: 100%: 3.5 lb/1000 sq. ft.
 - 3. Annual Ryegrass: 25: 2 lb/1000 sq. ft., Spring Oats: 75%.
- C. Seed Mix - Permanent:
 - 1. Kentucky 31 Tall Fescue: 38%: 1-2 lb/1000 sq. ft., or Reed Canary Grass or Smooth Brome Grass and Birdsfoot Trefoil: 45% (1,2,3).

2.03 FERTILIZER

- A. Commercial type, uniform in composition, free flowing, conforming to state and federal laws.
 - 1. Refer to Surface Water Control Drawing.
- B. Coordinate N-P-K requirements with those recommended by soil test report.

2.04 MULCH

- A. Straw or hay in air-dry condition substantially free of noxious weed seeds and objectional foreign matter.
 - 1. Refer to Surface Water Control Drawing.

2.05 LIME

- A. Refer to Surface Water Control Drawing.

PART 3 EXECUTION

3.01 PREPARATION

A. Topsoil:

1. Scarify subgrade to depth of 1 in. for bonding of subsoil with topsoil.
2. No topsoil shall be placed or worked in frozen or muddy condition.

B. Seeding:

1. Use Kentucky No. 31 Tall Fescue at 45-90 lb/acre (1-2 lb/1000 sq. ft).
2. Do not seed prior to topsoil application.
3. Do not seed on saturated or frozen soil.

3.02 TOPSOIL/FINISH GRADING

- A. Topsoil/Finish grade is established final grade as shown on Drawings. Grades not otherwise indicated are uniform levels or slopes between points where elevations given or between such points and existing finished grades.
- B. Grade, rake, and roll with roller weighing not more than 100 lbs/lin ft and not less than 25 lbs/lin ft.
- C. Maximum allowable variation from correct elevation is 2 in. in 10 ft.

3.03 SOWING

- A. Unless otherwise specified, seeds may be sown at option of CONTRACTOR by either Method A or Method B described below:

1. Method A:

- a. Sow selected seed mixture by means of equipment adapted to purpose, or it may be scattered uniformly over areas to be seeded, and lightly raked or dragged to cover seed with approximately one-fourth inch of soil.
- b. After seeding areas shall be lightly rolled or compacted by means of suitable equipment, preferably of cultipacker type when seed bed is either too loose or contains clods which would reduce germination of seed.
- c. Slopes steeper than three to one need not be rolled.
- d. Scattering seed by hand shall be done only with satisfactory hand seeders and only at such times when the air is sufficiently quiet to prevent seeds from blowing away.

2. Method B:

- a. Sow or spread seed by stream or spray of water under pressure operated from an approved type of machine designed for purpose.
- b. Place selected seed mixture and water into tank, within machine, in sufficient quantities that when contents of tank are sprayed on given area seed will be uniformly spread at required rate of application.
- c. During process stir or agitate contents of tank to provide uniform distribution of seed.
- d. Place contents of tank within two hours after seed is added to tank. Seed allowed to remain mixed with water for longer than two hours shall be rejected.
- e. Do not drag or roll.

3.04 MULCHING

- A. Mulch seeded areas within 3 days after seeding complete.
- B. Application rate shall be 2 tons per acre.
- C. Place mulch loose or open enough to allow some sunlight to penetrate and air to slowly circulate, but thick enough to shade ground, conserve soil moisture, and prevent or reduce erosion.
- D. Do not mulch during periods of excessively high winds.
- E. Mulch shall be anchored in the soil by the use of a mulch tiller.

3.05 CLEAN UP

- A. Paved surface and other site areas shall be kept clean of seeding, fertilizing and mulching materials.
- B. CONTRACTOR shall remove mulch that has blown onto area of liner placement. Removal shall take place to prevent delay of liner placement.
- C. Clean up shall occur at the end of each work day or as required by OWNER.

3.06 MAINTENANCE OF SEEDED AREAS

- A. Maintenance of seeded areas shall begin immediately following last seeding application. Continue until Work is accepted.
- B. Maintain seeded area by watering, mowing, and replanting as necessary to produce uniform stand of grass until Work is accepted.

3.07 ACCEPTANCE OF SEEDED AREAS

- A. CONTRACTOR shall notify OWNER in writing 2 days prior to inspecting seeded area.
- B. CONTRACTOR and OWNER shall inspect seeded areas for contract compliance and acceptance of work. Upon completion of inspecting seeded areas, OWNER shall provide written acceptance or rejection to CONTRACTOR with further requirements for completing the seeding work. Seeding work remaining to be completed shall be reinspected by OWNER before final acceptance.

* * * END OF SECTION * * *

SECTION 02984
RESTORATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Surface features
2. Pavements
3. Lawns
4. Signs.

1.02 QUALITY ASSURANCE

A. Requirements:

1. As defined in CQAP.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Plantings, Topsoil, Seed, and Other Related Materials: Comply with Section 02930 Topsoil and Seeding.

PART 3 EXECUTION

3.01 GENERAL

- A. Restore existing surface features, structures, and utilities disturbed by construction to condition equal to or exceeding that which existed prior to construction.
- B. Restore pavements, bases, and subbases of streets, roadways, driveways, alleys, and parking areas as specified herein. Restore curb and gutter, sidewalk, survey monument and lot pins, lawn and turf, and other existing surface features.
- C. Remove as necessary and replace to original location and condition, existing street signs, stop signs, mail boxes, right-of-way markers, plantings, and driveway markers, and other surface features.

3.02 TREES, PLANTS, SHRUBS, AND SEEDING

- A. Protect existing trees, plants, and shrubs.
- B. Seeding: Comply with Section 02930 Topsoil and Seeding.

3.03 PAVED AND IMPROVED SURFACES

- A.** Restore streets, alleys, driveways, parking areas, and other improved surfaces with granular subbase, base, and surface course to match existing.
 - 1. Concrete Drive: Section 3300.
 - 2. Other streets or roadways.
 - a. Equal to existing.
- B.** Restore curb and gutter driveway or sidewalk to cross-section equal to existing.
 - 1. Paving Contractor shall backfill behind curb and gutter.

*** * * END OF SECTION * * ***

DIVISION 3 - CONCRETE

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 REFERENCES

A. American Concrete Institute (ACI):

1. 117-90 - Standard Specification for Tolerances for Concrete Construction and Materials.
2. 318-92 - Building Code Requirements for Reinforced Concrete.
3. SP-66-88 - ACI Detailing Manual.

B. American Society for Testing and Materials (ASTM):

1. A185 REV A-90 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
2. A370-92 - Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
3. A615 REV A-92 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

C. American Welding Society (AWS):

1. D1.4-92 - Structural Welding Code Reinforcing Steel.

D. Concrete Reinforcing Steel Institute (CRSI):

1. Placing Reinforcing Bars.

1.02 SUBMITTALS

Not required.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Store reinforcing steel on supports above ground; cover and keep clean.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Reinforcing Bars:

1. Deformed bars conforming to ASTM A615, Grade 60.
2. Reinforcing Bars to be Welded: ASTM A706 and AWS D1.4.

B. Reinforcing Supports:

1. Exterior exposed surfaces, surfaces in contact with earth or liquid, and interior exposed surfaces in humid areas shall have all plastic or stainless steel supports.
2. Interior exposed surfaces in dry areas shall have all plastic, stainless steel, or plastic tipped steel supports.

2.02 FABRICATION

- A. Fabricate in accordance with ACI 318.

PART 3 EXECUTION

3.01 PLACEMENT

- A. Placement of reinforcing steel shall be approved by ENGINEER before covered with concrete.
- B. Correct displacement of reinforcement prior to and during concrete pouring operations. Maintain clear cover as noted on Drawings. Tolerances shall be in accordance with ACI 117 and ACI 318, unless noted otherwise.
- C. Support reinforcing steel in accordance with CRSI "Placing Reinforcing Bars" with maximum spacing of 4 ft-0 in.
- D. Tie reinforcing steel at intersections in accordance with CRSI "Placing Reinforcing Bars."
 - 1. Maximum Spacing for Slabs and Other Work: Every fourth intersection or 3 ft-0 in.
- E. Locate reinforcing to avoid interference with items drilled in later, such as concrete anchors.
- F. Use concrete brick for supporting bottom mat reinforcing on grade. Use bolsters or chairs supported on concrete brick or tied to bottom mat for supporting upper reinforcing mat on grade. Use bolsters or chairs for supporting reinforcing on mud slabs, metal deck, and forming.
- K. Do not field bend bars, including bars partially embedded in concrete unless indicated.
- L. Do not place bars having kinks and bends other than shown on approved Shop Drawings.
- M. Welding of reinforcing bars is permitted only where indicated or as otherwise approved by ENGINEER. Weld in accordance with AWS D1.4.
- N. Weld reinforcing steel only by welders certified in accordance with AWS D1.4.
- O. Tack welding reinforcement is prohibited.
- P. Reinforcement shall be clean and free from loose mill scale, dirt, grease, oil, form release agent, dried concrete or any material reducing bond with concrete.

* * * END OF SECTION * * *

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 REFERENCES

A. American Concrete Institute (ACI):

1. 117-90 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. 302.1R-89 - Guide for Concrete Floor and Slab Construction.
3. 308-92 - Standard Practice for Curing Concrete.

B. American Society for Testing and Materials (ASTM):

1. C31-91 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. C33-92 - Standard Specification for Concrete Aggregates.
3. C39-86 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. C94-92 - Standard Specification for Ready-Mixed Cement.
5. C143 REV A-90 - Standard Test Method for Slump of Hydraulic Cement Concrete.
6. C150-92 - Standard Specification for Portland Cement.
7. C172-90 - Standard Practice for Sampling Freshly Mixed Concrete.
8. C231 REV B-91 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
9. C260-86 - Standard Specification for Air-Entraining Admixtures for Concrete.
10. D1751-83 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

C. U.S. Army Corps of Engineers (CRD):

1. C513-74 - Specification for Rubber Waterstops.
2. C572-74 - Specification for Polyvinyl Chloride Waterstop.

1.02 SYSTEM DESCRIPTION

A. Tolerances:

1. Conform to requirements of ACI 117.
2. Minimum thickness of slabs and depth of beams shall be as dimensioned on Drawings. Pitch bottom of slab or beam to match top slope of slab or beam to maintain thickness or depth noted.

1.03 QUALITY ASSURANCE

- A. Plant Certification: Plant or concrete supplier shall comply with requirements of National Ready Mixed Concrete Association (NRMCA) certification plan as regards material storage and handling, batching equipment, central mixer, truck mixers with counters, agitators, nonagitating units, and ticketing system.
- B. Concrete Testing: Testing will shall be provided by OWNER in accordance with Section 01410 and this section.

1.04 PROJECT/SITE CONDITIONS

A. Hot Weather:

1. Comply with ACI 305R.
2. Concrete temperature shall not exceed 90°F.
3. At air temperatures of 80°F or above, keep concrete as cool as possible during placement and curing.
4. When concrete temperatures exceed 80°F, water reducing, set retarding admixtures shall be used in accordance with manufacturer's recommendations.

B. Cold Weather:

1. Comply with ACI 306R.
2. Temperature of reinforcement, forms, fillers, and other materials in contact with concrete at time of placement shall not be less than 35°F. Preheat if temperature below 35°F.
3. Maintain air and forms in contact with concrete sections having minimum dimension less than 12 in. at temperature above 50°F for at least first 3 days and at temperature above 32°F for remainder of specified curing period.
4. Maintain air and forms in contact with concrete in more massive sections at temperature above 40°F for at least first 3 days and at temperature above 32°F for remainder of specified curing period.

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland Cement:

1. ASTM C150.
2. Nonhydraulic Structures: Type I or II except tricalcium aluminate (C_3A) content of Type I shall not exceed 12%.
3. Hydraulic Structures: Type I or II except tricalcium aluminate (C_3A) content of Type I shall not exceed 8%. If this type of Type I not available, Type I with C_3A content less than 12% shall be used in combination with fly ash.
4. Hydraulic Structures: Type I or II except tricalcium aluminate (C_3A) content for both shall not exceed 5%. If these types not available, Type I with C_3A content less than 8% or Type II shall be used in combination with fly ash.
5. Type III may be substituted for Type I when approved by ENGINEER and additional requirements for Type I stated above are met.

B. Aggregates:

1. ASTM C33, modified as follows.
 - a. Fine Aggregate: Natural sand.
 - b. Coarse Aggregate: Crushed gravel, crushed stone or gravel, Size 467 (1-1/2 in. maximum), Size 67 (3/4 in. maximum), Size 8 (3/8 in. maximum).
2. Potential reactivity of aggregates shall be determined in accordance with Appendix XI of ASTM C33.

C. Admixtures for Concrete:

1. Air-Entraining: ASTM C260.
2. Chemical Admixtures: Optional, ASTM C494, non-corrosive and chloride free.

3. Chemical Admixtures for Flowing Concrete, ASTM C1017:

- a. Type 1, Water reducing, high range.
- b. Type 2, Water reducing and retarding, high range.

E. Water: Potable.

F. Premolded Joint Filler:

1. ASTM D1751.
2. ASTM D1752, Type I, II or III.
3. Closed cell polyethylene.

G. Waterstops:

1. Virgin polyvinyl chloride (PVC) waterstop conforming to CRD C572.
2. Rubber waterstop conforming to CRD C513.
3. Construction and Contraction Joints: Rubber or PVC, dumbbell or serrated type, 6 in. wide by 3/8 in. thick, at center. If 4-in. wide waterstop indicated on Drawings, waterstop shall be 3/16 in. thick at center.

H. Cement Grout: Mixture of cement and fine sand in proportions used in concrete being finished.

I. Form Release Agent:

1. Manufacturers:
 - a. Debond by L&M Construction Chemicals, Inc.
 - b. Cast-Off by Sonneborn.
 - c. Eucoslip by Euclid Chemical Company.
 - d. Clean-Strip J-1 by Dayton Superior.
2. Nontoxic and nonresidual.
3. Compatible with concrete admixtures.

2.02 CONCRETE MIX DESIGN

A. Concrete Mix: Measure and combine cements, aggregates, water, and admixtures in accordance with ASTM C94 and ACI 211.1.

1. Cement: When used in exposed concrete shall be one brand from one source. Do not mix different cements in same element or portion of Work.
2. Water-Cement Ratio: 0.45 maximum. If fly ash is used, water-cement plus fly ash ratio 0.45 maximum.
3. Air-Entrainment: Air-entrain concrete exposed to freezing or liquid containment.
4. Chemical Admixtures: Use is optional to aid concrete properties and allow for efficient placement. Manner of use and amount shall be in accordance with manufacturer's written recommendations and as approved by ENGINEER. Do not use admixtures which increase early shrinkage or negatively affect finishing.
5. Waterproofing Admixture: Provide waterproofing admixture at dosage rate of 13 oz per bag of Portland cement for concrete in following:
6. Use no admixture other than specified, unless approved by ENGINEER.

B. Class of Concrete:

1. Furnish in accordance with table. Cement contents listed are minimum values and shall be increased as required to attain other specified characteristics.
2. Air contents listed are for concrete requiring air-entrainment as specified herein. Contents listed shall be maintained after addition of admixtures.
3. Slumps listed are maximum, except when high range water reducer is used. Maximum slump when high range water reducer is used, 10 in.
4. Chloride ion content shall not exceed values listed in ACI 318, Table 4.3.1.

Class	Compressive Strength (psi)	Coarse Aggregate (size No.)	Minimum Cement Factor (bags/cu yd)	Air Content (%)	Slump (in.)
AA	4,000	None	8.0	8 ±2	6 maximum
A1	4,000	467	5.5	5½ ±1	3 ±1
A2	4,000	67	6.0	6 ±1	3 ±1
B1	3,000	467	4.5	5½ ±1	3 ±1
B2	3,000	67	4.75	6 ±1	3 ±1
B3	3,000	8	5.0	7 ±1	4 maximum
C	4,000	467	6.0	6 ±1½	3 ±1
F	2,000	67	2.25	---	---

C. Concrete Usage:

1. Class A: All locations.

2.03 MIXING AND DELIVERY

- A. Use ready mixed concrete.
- B. Deliver and complete discharge within 1-1/2 hrs of commencing of mixing or before 300 revolutions of drum or blades, whichever comes first. Includes revolutions required by transit mix trucks. Limitations may be waived by ENGINEER if concrete slump, after 1-1/2 hrs or 300-revolution limit reached, that concrete can be placed without addition of water. In hot weather, time or number of revolutions criteria may be reduced by ENGINEER.
- C. Do not add water on-site unless slump, after addition of water, is below maximum allowed. If water added, mix concrete at site additional 30 revolutions of drum.
- D. Deliver concrete to site having temperature not less than 50°F nor greater than 90°F.
- E. If high range water-reducing admixture added on-site, mix concrete at site additional 85 revolutions of drum after addition of high range water-reducing admixture.

PART 3 EXECUTION

3.01 FORMS

- A. Formwork design, detailing, and installation shall be CONTRACTOR'S responsibility and shall conform to requirements of ACI 347R.
- B. Materials and Construction: Type of forms used is CONTRACTOR'S option, except as otherwise indicated below or on Drawings. Plywood and other wood surfaces shall have smooth, level surfaces treated with form oil or sealer to produce clean release of concrete from forms.
 - 1. Where walls remain exposed use plywood, prefabricated metal or wood forms. Do not use boards.
 - 2. Use bolts, rods or other approved devices for form ties. Plastic cone snap ties are approved as form ties. Ties for liquid holding structures or dry structures below grade shall have integral waterstop. Do not use wire ties on exposed concrete.
 - 3. Ties shall be removed minimum of 1 in. from formed surface. Removal of ties shall leave holes clean cut and without appreciable spalling at face of concrete. Provide plastic cone or other approved device.
 - 4. Provide 3/4 in. chamfer on external corners of exposed concrete walls, beams, columns, equipment bases and exposed edges of construction joints. Do not chamfer columns flush with concrete block walls.
 - 5. Provide openings at base of vertical forms as access for cleaning and inspection of forms and reinforcing prior to depositing concrete.
- C. Treat or Wet Contact Forms: Coat plywood and wood moldings with non-staining form release agent. Apply release agent before reinforcement is placed.
- D. Workmanship:
 - 1. Formwork shall prevent leakage of mortar, shall not deflect under weight of concrete and workman, and shall withstand fluid pressures of concrete.
 - 2. Removal of wall ties shall leave holes clean cut and without appreciable spalling at face of concrete.

3.02 SUBGRADE PREPARATION

- A. Subgrade and bedding shall be compacted and free of frost. If placement allowed at temperatures below freezing, provide temporary heat and protection to remove frost. Do not place concrete on frozen material.
- B. Remove standing water, ice, mud, and foreign matter before concrete deposited.

3.04 PLACING CONCRETE

- A. Notify OWNER 24 hrs in advance of placing operation.
- B. Place concrete, except as modified herein, in accordance with ACI 304R, Chapter V.
- C. Concrete will not be allowed to drop freely where reinforcing will cause segregation of mix.
 - 1. Other Concrete: 5-ft maximum drop.

3.05 JOINTS

- A. Unless otherwise noted, construction joints shown are optional. Joints shall be approved by ENGINEER. Locate to miss splices in reinforcement.

3.06 FINISHING FORMED CONCRETE

- A. Ordinary Finish: Finish resulting directly from formwork for surfaces which will be hidden from view by earth, submergence in water or sewage or subsequent construction.
 - 1. Patch honeycombing, stone pockets, form ties, spalls, and other irregularities as specified in this section and cure.
 - 2. Where joint marks or fins on submerged surfaces exceed 1/4 in., grind smooth.

3.07 PROTECTION AND CURING

- A. Protect concrete from frost and keep moist for minimum curing period of 7 days after placing in accordance with ACI 308.
- B. Formed Surfaces:
 - 1. Wet cure by spraying surfaces during curing period as frequently as drying conditions may require to keep concrete surfaces moist.
- C. Curing Compound:
 - 1. Apply curing compound at uniform rate sufficient to comply with requirements for water retention as specified and as measured in accordance with ASTM C156.
 - 2. Cover areas subjected to direct sunlight during curing period with ambient temperature expected to exceed 80°F with white pigmented compound, others may be covered with fugitive dye compound.

3.08 FIELD QUALITY CONTROL

- A. Strength level of individual class of concrete considered satisfactory if following requirements met.
 - 1. Average of all sets of 3 consecutive strength tests equal or exceed specified 28-day compressive strength.
 - 2. No individual strength test falls below specified 28-day compressive strength by more than 500 psi.
- B. If analysis of strength tests indicates above requirements are not being met, make immediate adjustments to mix. Also, if likelihood of low strength concrete is confirmed, make additional tests as required by ENGINEER to determine strength of concrete in-place in portion of structure identified with deficient cylinders. If tests and analysis verify Work in-place is not in conformance with Specifications, ENGINEER will determine whether or not Work in-place is adequate for intended use in location. If Work is determined inadequate, CONTRACTOR shall follow such remedial or replacement measures which ENGINEER may require. CONTRACTOR shall bear costs in connection with testing, engineering analyses, remedial work, and replacement required under terms of this paragraph.

* * * END OF SECTION * * *

SECTION 03604
NONSHRINK GROUT

PART 1 GENERAL

1.01 REFERENCES

A. U.S. Army Corps of Engineers (CRD):

1. C621-89 - Specification for Nonshrink Grout.

B. American Society for Testing and Materials (ASTM):

1. C1107 REV A-91 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

1.02 SUBMITTALS

A. Product Data:

1. Manufacturer's literature.

B. Submit in accordance with Section 01340.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manufacturers:

1. NBEC, Five Star Products, Inc.
2. Masterflow 713 Grout. Master Builders.
3. Euco N-S Grout, Euclid Chemical Company.
4. Crystex, L&M Construction Materials, Inc.

B. Grout:

1. Cement base, nonmetallic, nongas forming, nonshrink, preblended and ready-to-use requiring only addition of water at Project site.
2. Comply with ASTM C1107 and CRD C621, Grade C.
3. Of moderate fluidity with minimum compressive strength of 5,000 psi at 28 days and shall not bleed.

C. Water:

1. Clean and free from injurious chemicals and deleterious materials.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean grout contact surfaces of oil, grease, scale, and other foreign matter. Chip away unsound concrete leaving surface level but rough.

- B. Underside of base plates of machinery, rails, and bolts shall be free of grease, oil, dirt or coatings.

3.02 MIXING AND PLACING

- A. Mix and place in accordance with manufacturer's written instructions.
- B. Provide sealing materials where necessary to retain grout until hardened.
- C. Work grout from one side to other. Avoid trapping air under base plates.
- D. Remove plastic anchor bolt sleeve tops where used, and fill with grout at same time base plates are grouted.

3.03 CURING

- A. Cure with curing compound or as recommended by grout manufacturer.

* * * END OF SECTION * * *

DIVISION 11

SECTION 11309
VERTICAL PUMPS

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

A. Design Criteria:

1. Design pumps for conditions given in Schedule 1 to Section 11309.
2. Working parts to be readily accessible for inspection and repairs, easily duplicated, and replaced.
3. Construct suitable for submerged installation.
4. Direct connect to vertical shaft motor.
5. Design to operate safely in reverse direction of rotation due to water returning through pump. Provide check valve integral with pump to reduce reverse water flow direction.
6. Lubrication system shall be as automatic as possible.
7. Equipment shall be free from shock, vibration, and noise under conditions of load.
8. Bearings and similar parts shall have temperature rise not exceeding limit of safety and good practice for such parts.

1.02 SUBMITTALS

A. Product Data:

1. Pump Data:

- a. Pump application.
- b. Pump manufacturer.
- c. Pump type.
- d. Pump size.
- e. Capacity at design head.
- f. Pump speed (minimum and maximum rpm).
- g. Pump efficiency at design conditions.
- h. Overall efficiency at design conditions.
- i. Size of solids handling capability.
- j. Suction size.
- k. Discharge size.
- l. Size of pump shaft at stuffing box.
- m. Size of intermediate shafting (if applicable).
- n. Number of intermediate shafting (if applicable).
- o. Column size (if applicable).
- p. Bowl size (if applicable).
- q. Lubricating system.
- r. Pump, base, and shafting weight.

2. Motor data:

- a. Motor make.
- b. Motor type.
- c. Thermal protection (Yes).
- d. NEMA design.
- e. NEMA insulation class.
- f. Full load amperage.
- g. Locked rotor amperage.

- h. Weight.
- i. Voltage.
- j. Horsepower.
- k. Full speed (rpm).

3. Characteristic Curves:

- a. Manufacturer equipment curves showing principal characteristics of pumps.
- b. Curves shall show relationship between delivery and head from zero delivery to maximum delivery of pumps and relationship between efficiency and delivery and hp shaft input of pumps between limits stated above.
- c. Furnish overall efficiency curve for each unit.
- d. Draw curves to scale that values can be read accurately within 1%.

B. Shop Drawings:

- 1. Indicate size and dimensions of equipment and appurtenances.

C. Submit above in accordance with Section 01340.

- 1. Furnish within 30 days after Notice of Award.

D. Operation and Maintenance (O&M) Data:

- 1. Manufacturer's written installation instructions.
- 2. Manufacturer's written operation and maintenance instructions.
- 3. Submit in accordance with Section 01730.

1.03 QUALITY ASSURANCE

A. General:

- 1. Equipment shall be adapted to best economy, both in power consumption and maintenance, under continuous operation incident to service specified.
- 2. No equipment will be considered which has not demonstrated its reliability and efficiency by installation of similar units of approximately same capacity operating under conditions corresponding to conditions affecting specified units.

B. System Responsibility:

- 1. To ensure proper operating system, manufacturer of leachate pump equipment specified herein shall be responsible for providing associated groundwater pump control panel as shown in Drawings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Grundfos Pumps Corporation.
- B. Or equal.

2.02 SUBMERSIBLE PUMPS

- A. Pump and motor designed for continuous submerged operation.

- B. Check valve integral to pump discharge housing.
 - 1. Construct of 300 series stainless steel.
- C. Pumping downthrust absorbed by motor thrust bearing.
 - 1. Adjustable Mitchell design (improved "Kingsbury" type).
 - 2. Construct of ceramic running against self-aligning metal impregnated carbon pads.
- D. Stainless steel priming inducer.
 - 1. Design to ensure proper pump cooling and prevent dry running when liquid level drops below pump intake.
- E. Stainless steel filter screen.
 - 1. Integral to suction inlet assembly.
- F. Fabricated stainless steel diffuser guide vanes.
- G. Fabricated stainless steel impellers.
 - 1. Fit seal ring around each impeller eye or skirt.
 - a. Construct seal rings of stainless steel tetrafluoroethylene (TFE).
- H. Centerless ground stainless steel pump shaft.
- I. TFE shaft bearings of hexed design.
- J. Stainless steel split cones and split cone nuts.
- K. Integral fabricated stainless steel diffuser chambers.
 - 1. Design to eliminate up thrust.
 - 2. Container diffuser guide vanes and intermediate shaft bearings.
- L. High tensile strength stainless steel straps.
- M. Splined or keyed stainless steel pump shaft coupling.
- N. Motor:
 - 1. Canned rotor design.
 - 2. Hermetically sealed epoxy encapsulated stator sealed in stainless steel enclosure.
 - 3. Stainless steel clad rotor.
 - 4. Construct parts in contact with pumped liquid, of stainless steel.
 - 5. Shaft and seal:
 - a. Tungsten carbide running on tungsten carbide.
 - b. Upper seal ring molded into spring loaded rubber diaphragm.

6. Upper radial bearing:
 - a. Diamond hard ceramic running against tungsten carbide shaft journal.
 - b. Lubricated by pumped fluid.
7. Motor circulation pump:
 - a. Stainless steel.
 - b. Circulate pumped fluid in rotor.
 - c. Design to ensure effective bearing lubrication and winding heat dissipation.
8. Lower radial bearing:
 - a. Diamond hard ceramic running against tungsten carbide shaft journal.
 - b. Lubricated with pumped fluid.
9. Viton diaphragm:
 - a. Design to automatically compensate for internal motor liquid expansion due to temperature or pressure changes.
10. Provide neoprene jacketed RHW insulated power cable.

2.03 SERVICE CABLE

- A. Provide each pump with 40-ft, factory installed, sealed, heavy duty, electric service cable.
- B. Splice incoming wire in splice box attached to protective wellhead vault.
- C. After splicing, fill terminal housing with epoxy to seal outer core jacket and strands.
- D. Provide secondary elastomer compression grommet to ensure complete sealing and strain relief.
- E. Provide groundwater pumps with bare end cables to be hard wired to local control panels.
- F. Provide top anchor for cable strain relief in well.

2.04 ACCESSORIES

- A. 1-in. dia hose for use with pump.
- B. Pull-out Cable: Provide 1/8-in. stainless steel, pull-out cable.
 1. Length of cable varies with well depth.
 2. Minimum Breaking Strength: 1,700 lbs.
 3. Conform to applicable FS RR-W-410C and MIL-W-83420D.
 4. Good flexibility and designed for use on small dia pulleys and winches.
 5. Secure cable to pump with stainless steel hardware.

2.05 SOURCE QUALITY CONTROL

A. Factory Tests:

1. Perform factory certified test on each pump in accordance with test requirements of Hydraulic Institute.
2. Test shall determine capacity, head, power input, efficiency, and water hp.
3. Minimum of 6 points shall be taken including rated condition and shut-off.
4. Supply certified performance curves.
5. Subject pumps to hydrostatic test and provide certification of hydrostatic test. Hydrostatic pressure shall be not less than 1-1/2 times shut-off pressure of pump.
6. Prior tests on similar or identical pumps will not be acceptable.

2.06 SUBMERSIBLE LEVEL SENSOR

- A. Construct submersible pump with housing to contain pressure transducer holder.
- B. Pressure transmitter level sensor shall be sealed for temperature compensation and barometric pressure equalization with permanently bonded, chemical-resistant signal cable suitable for intended operation.
- C. Transmitter diaphragm shall be constructed of Type 316 stainless steel with viton seals.
- D. Lead wire shall have flexible jacket protected from moisture absorption and vented for barometric pressure changes.
- E. Pressure transmitter shall activate automated level sensor controller as specified in Paragraph 2.07.

2.07 LEVEL CONTROLLER

- A. Level controllers shall operate from 120 v, 60 Hz, single-phase power supply, be mounted on inner door equipped with digital readout meter capable of monitoring and maintaining automatic pump operations and at least 2 other level signals, with accuracy to within 0.1 in.
- B. User-specified input variables shall allow user to determine up to 4 specific setpoints to operate pumps and auxiliary equipment according to design parameters as specified in Article 2.06.
- C. Display range: Meter shall be preset to display full range of transmitter level sensor. Meter shall have integral digital display of level in feet, graduate in tenths.
- D. Programmability: Meter shall be front panel programmable for start and stop levels and high and low alarm levels.
- E. Display update shall update its display 2.5 times/sec nominal.
- F. Response time shall be less than 500 ms for input step change (step=25% full scale).
- G. Temperature range shall maintain full function in temperatures between 0° and 100°F.
- H. Nonvolatile memory shall retain programmed set points even when power to meter is interrupted.
- I. Level control operation shall be actuated from submersible pump pressure transmitter.
- J. Transmitter circuit shall be protected by intrinsically safe barriers.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment according to manufacturer's written instructions and approved submittals.
- B. Provide necessary oil and grease for initial operation, using grades recommended by manufacturer.
- C. Wire in accordance with Division 16.
- D. Attach pump power cable to stainless steel pump pull-out cable at 5-ft intervals using nylon ties.

3.02 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services:
 - 1. Supplier's or manufacturer's technician for equipment specified herein shall be present at job site for minimum of 1 manday, travel time excluded, for service during hookup and training of OWNER'S personnel for operation.
 - 2. Supplier or manufacturer shall direct services to specific system and equipment operation, maintenance and troubleshooting. See Section 01600.

SCHEDULE 1 TO SECTION 11309 VERTICAL PUMP AND ELECTRICAL MOTOR CHARACTERISTICS	
<i>Pump Characteristics</i>	
Pump Designation	Groundwater Pump
Number of Units	3
Materials Being Pumped	Groundwater
Minimum Solids Size (in.)	NA
Constant or Variable Speed	Constant
Configuration (1)*	e
Minimum Suction Size (in.) (2)*	Inducer Sleeve
Minimum Suction Size (in.) (2)*	Inducer Sleeve
Minimum Discharge Size (in.) (2)*	1 1/2" NPT
Rated Capacity (gpm)	27±
Total Dynamic Head at Rated Capacity (ft) (3)*	50
Minimum Capacity (gpm)	20
Total Dynamic Head of Minimum Capacity (ft) (3)*	60
Minimum Efficiency of Pump at Rated Capacity	--
Maximum Pump Speed (rpm)	--

**SCHEDULE 1 TO SECTION 11309
VERTICAL PUMP AND ELECTRICAL MOTOR CHARACTERISTICS**

Lubrication (4)*	Pumped Fluid
Rotation when Viewed from Driver	Clockwise
Type of Drive (5)*	NA
Special Requirements	All Stainless Steel Construction
<i>Electric Motor Characteristics</i>	
Horsepower	0.5
Rated Speed (rpm)	3450
Service Factor	--
Housing Type (7)*	Submersible
NEMA Design	B
Insulation Class	F
Voltage	115/230V
Phase	1
Special Requirements	Submersible
<p>()* Indicates footnotes on following page. NA Indicates not applicable.</p>	
<p>1. Configuration can be:</p> <ul style="list-style-type: none"> a. Propeller pump - axial flow. b. Propeller pump - mixed flow. c. Vertical turbine pump - enclosed impeller. d. Vertical turbine pump - semi-open impeller. e. Vertical submersible pump. 	

SCHEDULE 1 TO SECTION 11309
VERTICAL PUMP AND ELECTRICAL MOTOR CHARACTERISTICS

2. If sizes larger than those shown are furnished, CONTRACTOR shall be responsible for added expense of piping and changes in drawings
3. Does not include elbow, column, strainer, and other internal losses in pump.
4. Product lubricated or oil lubricated.
5. Type of drive can be:
 - a. Variable frequency.
 - b. Magnetic coupling (eddy current coupling).
 - c. Wound rotor.
 - d. Fluid drive.
 - e. Variable sheave (local or remote control).
6. General type can be:
 - a. Squirrel cage.
 - b. Wound rotor.
 - c. Synchronous.
7. Housing type can be:
 - a. ODP (open dripproof).
 - b. TEFC (totally enclosed fan cooled).
 - c. Explosionproof.
 - d. Submersible.
 - e. Splashproof.
 - f. Weather protected.

* * * END OF SECTION * * *

DIVISION 13

**SECTION 13621
SAMPLING EQUIPMENT**

PART 1 GENERAL

1.01 SUMMARY

A. Description of System:

1. Provide one portable automatic sampler to collect, composite, and preserve uniform liquid samples of effluent from groundwater interception system.

B. Work by Others:

1. ELECTRICAL CONTRACTOR shall provide electrical wiring and controls as specified in Division 16 except those specified in this section.

1.02 QUALITY ASSURANCE

A. Supplier's or Manufacturer's Services:

1. Supplier or manufacturer shall direct services to specific system and equipment operation, maintenance, and troubleshooting. Process design and philosophy will be presented by ENGINEER. See Section 01600.

PART 2 PRODUCTS

2.01 PORTABLE AUTOMATIC SAMPLERS

A. Manufacturers:

1. ISCO, Instrument Specialties Company, Model 3700 C.
2. Or equal.

B. Provide 1 portable automatic sampler capable of operating on contained power source (12 vdc and on 115 v, 60 Hz electric service).

C. Provide samplers with not less than 24 sample bottles. Interval between samples shall be switch selectable. Provide peristaltic pump capable of not less than 20 ft of suction lift to draw samples and purges suction line before and after sample collected.

D. Sampler case capable of being placed in 20-in. manhole.

E. Automatically shut off sampler pump when individual sample bottle full.

F. Samplers capable of withstanding accidental submersion.

G. Provide each sampler with following.

1. ABS plastic or fiberglass sealed, high impact carrying case.
2. 1-in. polystyrene insulation, completely protecting sample.
3. Two high density polyethylene sample containers for composite sampling with one base.
4. Two clear flexible vinyl sampling lines, 3/8 in. ID each, 20 ft-0 in. in length.

5. One weighted strainer to keep rags and other debris from entering sampler line.
6. Two rechargeable NiCad batteries.
7. One suspension harness.

H. Sampler to accept 4-20 milliamp signal from flowmeter to allow for flow-proportional sampling.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment in accordance with manufacturer's written instructions.

* * * END OF SECTION * * *

SECTION 13623
FLOW METER (MAGNETIC)

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Magnetic flow meters.
2. Converters.
3. Interconnecting cable.

B. Work by Others:

1. ELECTRICAL CONTRACTOR shall provide electrical wiring and controls other than those included in this section as specified in Division 16.

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. Comply with Schedule 1 to this section.
2. Ratio of flow velocity to reference voltage signals generated identical for each meter size. Meter shall be compatible with secondary readout instrument without circuit modifications.
3. Changes in density, viscosity, temperature, pressure or conductivity within limits of flow meter shall not affect accuracy. Maintain accuracy for field repairs performed by supplier's service technician during warranty period.
4. Design is based on minimum average velocity of 3 ft/sec through meter. Meters requiring greater velocities to meet specified accuracy and proper performance are not acceptable.
5. Flowmeter system accuracy shall be $\pm 0.5\%$ of flow rate over 10:1 turndown. Repeatability shall be $\pm 0.1\%$ and response time programmable from 1 sec to 100 sec.
6. Transmitter to provide 4 - 20 milliamp signal to water sampler for collection of flow-proportioned effluent samples.
7. Transmitter to provide both instantaneous flow reading (gpm) and non-resettable total flow passed (gallons).

1.03 SUBMITTALS

- A. General:** If CONTRACTOR provides equipment of named manufacturer(s) without deviations submittals are not required. If CONTRACTOR is proposing substitute to named manufacturer(s), submittals below are required. O&M data is required for named and substitute manufacturers.

B. Shop Drawings:

1. Drawing showing location of meter in pipe system.
2. Wiring diagram between meter and converter.

C. Product Data:

1. Catalog cuts and manufacturer's specification for each meter and converter.
2. Standard wiring diagrams.

D. Submit in accordance with Section 01340.

E. Operation and Maintenance (O&M) Data:

1. Hydraulic calibration results including printout of actual calibration data giving indicated vs. actual flows at minimum of 3 flow rates for each meter. Identify results by serial number of each meter.
2. Submit in accordance with Section 01730.

1.04 MAINTENANCE

A. Extra Materials:

1. One signal converter for each type used on Project.
2. One set of special tools and test equipment, including calibrator required for repair and recalibration of equipment.
3. One spool piece for each size of meter for replacement in-line when meter is removed for repair.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Foxboro Model 8002A-WPR-SJGFZ-A Flotube with IMT 20-SA15FGZ -T Transmitter.
- B. Krohne.
- C. Or equal.

2.02 FLOW METER

- A. Low frequency, electromagnetic induction type and shall produce dc pulse signal directly proportional and linear to liquid flow rate.
- B. Splashproof and weather-resistant NEMA 4 design housing with accidental submergence rating, 30 ft water for 48 hrs. Watertight external and internal electrical conduit connections.
- C. Provide power from signal converter.
- D. Flow meter liner, electrode materials, and electrode type shall comply with materials listed on Schedule 1 of this section.
- E. Use grounding rings or gaskets on each end of magnetic flow meter to provide ground path and prevent interference with flow signal. Probes are not acceptable.
- F. Sensing head interchangeable with meter body of same manufacturer without performing flow recalibration.
- G. High impedance device of not less than 10^{12} ohms to minimize span shift due to electrode coating.
- H. Explosionproof sensor certified by Factory Mutual Research for Class I, Division I, Groups C and D when sensor is located in hazardous area.

2.03 SIGNAL CONVERTER

- A. Remote or integrally mounted, microprocessor controlled.

1. Operate on 120 vac, 60 Hz power.
2. Provide pulsed dc voltage to magnet coils of magnetic flow meter to establish magnetic field.
3. Convert flow signal from magnetic flow meter to analog and digital output signals, for bidirectional flow.

- B. Span to be continuously adjustable between 2 and 31 ft/sec. Adjustment shall be by keypad.
- C. Display shall have 2 rows of 16 alpha numeric characters. Top row shall indicate instantaneous flow rate in direct engineering units, field selectable.
- D. Converter interchangeable with magnetic flow meter of same manufacturer and requires no additional flow calibration adjustment.
- E. 4-20 mA dc analog current output into 0 to 900 ohm load and 24 vdc scaled, pulse output software adjustable.
- F. Locate flow rate indicator within each converter. Indicator shall display flow rate in engineering units as shown in Schedule 1.
- G. House in cast aluminum enclosure to meet NEMA 4X requirements.
- H. Noise reduction feature to minimize effects of noise generating processes.
- I. Automatic empty pipe detection.
- J. Suitable for -40°F to 150°F ambient temperature.

2.04 CABLE

- A. Provide sufficient length of signal cable as standard with manufacturer to connect meter and converter.
- B. Use single conduit run between converter and meter.

2.05 SOURCE QUALITY CONTROL

- A. Hydraulically calibrate flow meter at facility located in United States and calibration traceable to National Institute Standards Testing or Institute of Science and Technology.
- B. Wire and test meter, suitable for operation.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's written instructions and approved submittals.
- B. Locate meter as recommended by manufacturer with respect to other piping components to ensure meter will meet specified accuracy.

3.02 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services:
 1. Supplier's or manufacturer's technician for equipment specified herein shall be present at job site or classroom designated by OWNER for mandays indicated, travel time excluded, for assistance during

plant construction, plant startup, equipment calibration, and training of OWNER'S personnel for plant operation. Include minimum of:

- a. 0.5 mandays for Installation Services.
 - b. 0.5 mandays for Instructional Services.
2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, and troubleshooting and system-related areas other than process design and philosophy. See Section 01600.

SCHEDULE 1 TO SECTION 13623

MAGNETIC FLOW METER SCHEDULE

Tag No.	Description	Process Media	Min Flow	Calibrated Range	Size (in.)	Materials of Construction
001	Effluent Flowmeter	Groundwater	0	0-100	2	1, 9, 8, 10, 12

Electrode Type

- 1. Plain (Flush)
- 2. Bullet Nose

Liner Material

- 3. Teflon
- 4. Polyurethane
- 5. Neoprene
- 9. 304 Stainless Steel

Electrode Material

- 6. Zirconium
- 7. Tantalum
- 8. Stainless Steel

Flange Material

- 10. Carbon Steel
- 11. 304 Stainless Steel

Flange Rating

- 12. ANSI 150
- 13. ANSI 300

*** END OF SECTION ***

DIVISION 15 - MECHANICAL

SECTION 15078
POLYVINYL CHLORIDE (PVC) PIPE

PART 1 GENERAL

1.01 SUBMITTALS

A. Product Data:

1. Submit product data for pipe, fittings, flanges, gaskets, and bolting.
2. Submit proposed gasket material for each service. Submit document confirming gasket material selection is appropriate for fluid carried in system.

B. Submit in accordance with Section 01340.

PART 2 PRODUCTS

2.01 PVC MATERIAL

A. Type 1, Grade 1 conforming to ASTM D1784.

2.02 PIPE

A. Schedule 80 PVC conforming to ASTM D1785.

2.03 FITTINGS

A. Schedule 80 PVC.

1. ASTM D2467 for socket joint type.

2.04 JOINTS

- A. Provide socket type at all locations except unions, valves, and equipment with threaded or flanged end connections.
- B. Threaded connections are not acceptable for nominal piping size greater than 2 in.
- C. Do not provide threaded joints for piping systems identified on Drawings or in other Sections to be provided without threaded joints.

2.05 FLANGES

A. PVC, 1-piece socket type, flat faced, conforming to ANSI B16.5 150-lb bolt hole drilling pattern.

2.06 GASKETS

- A. Full-face, 1/8-in. thick flat type.
- B. When mating flange has raised face, use flat ring gasket and provide filler gasket between outside diameter of raised face and flange outside diameter to protect flange from bolting moment.

- C. Material compatible with fluid carried in system.

2.07 BOLTING

- A. Type 316 Stainless Steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts.
- B. Bolts shall conform to ANSI B.1.20.1.
- C. Provide washers same material as bolts.

2.08 SOLVENT CEMENT

- A. Join socket connections with PVC solvent cement conforming to ASTM D2564.
- B. As recommended by pipe and fitting manufacturer to assure compatibility.

2.09 THREAD LUBRICANT

- A. Teflon tape.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products as shown on Drawings, and as specified in applicable piping system specification section(s).
- B. Install products in accordance with manufacturer's written instructions.

* * * END OF SECTION * * *

SECTION 15079
HIGH DENSITY POLYETHYLENE (HDPE) PIPE

PART I GENERAL

1.01 SUBMITTALS

A. Product Data:

1. Manufacturing test specification data listing resin type, cell classification, stock density, melt flow, flexural modulus, tensile strength, and coloration.
2. Include test results with shipment of materials, with 2 additional copies of test results furnished to ENGINEER.
3. Pipe Dimensions:
 - a. Average outside diameter.
 - b. Average inside diameter.
 - c. Minimum and average wall thickness.

B. Submit in accordance with Section 01300 01340.

1.02 QUALITY ASSURANCE

A. Comply with appropriate codes and standards of following organizations for handling, heat fusion, and underground installation of low pressure polyethylene pipe.

1. American Gas Association (AGA).
2. Plastic Pipe Institute (PPI).

1.03 DELIVERY, STORAGE, AND HANDLING

A. Pipe Storage:

1. Store or stack pipe to prevent damage from marring, crushing or puncture. Limit maximum stacking height to 6 ft.
2. Store in accordance with manufacturer's recommendations.

B. Pipe Handling:

1. Protect pipe from excessive heat or harmful chemicals.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manufacturers:

1. Phillips Driscopipe, Inc., Richardson, Texas.
2. Plexco, Amsted Industries, Franklin Park, Illinois.

3. Poly Pipe Industries, Gainesville, Texas.
4. Or equal.

B. Physical Properties of Pipe Resin:

1. Density: ASTM D1505, not less than 0.941 - 0.955 gms/cu cm.
2. Melt Flow: ASTM D1238 - Condition E, not greater than 0.15.
3. Flexural Modulus: ASTM D790, 110,000 to less than 160,000 psi.
4. Tensile Strength at Yield: ASTM D638, 3,000 to less than 3,500 psi.
5. Environmental Stress Crack Resistance (ESCR): ASTM D1693 - Condition C, shall be in excess of 5,000 hrs with zero failures.
6. Hydrostatic Design Basis: ASTM D2837, 1,600 psi at 23°C.

C. High performance, high molecular weight, high density polyethylene pipe (Type 3408 resin).

D. ASTM D1248 (Type III, Class C, Category 5, P34).

E. ASTM D3350, minimum cell classification value 345434C.

F. Standard dimension ratio SDR 11.

G. Marking: Intervals of 5 ft or less.

1. Manufacturer's name or trademark.
2. Nominal pipe size.
3. Type of plastic pipe (i.e., PE 3408)
4. Standard dimension ratio SDR 11.
5. ASTM D2513.
6. Extrusion date, period of manufacture or lot, or batch number.

H. Dimensions:

1. Conform to standard dimensions and tolerances of ASTM D2513.

2.02 FITTINGS

A. Fittings from polyethylene compound having cell classification equal to or exceeding compound used in pipe to ensure compatibility of polyethylene resins.

B. Provide molded fittings rather than factory fabricated fittings in available diameters.

C. Be of same manufacture as pipe being provided. ENGINEER may allow substitution for approved material with use of flanged joint sections.

D. Flange Joints:

1. 150-lb carbon steel or convoluted epoxy coated ductile iron backup flanges as recommended by manufacturer.
2. Cadmium plated carbon steel nuts and bolts.
3. Flanges and bolt patterns consistent with ANSI B16.5, AWWA C207, ASTM A536, and as recommended by manufacturer.

E. Fitting dimensions shall conform to standard dimensions and tolerances, ASTM D3261.

F. Markings, ea. fitting:

1. Manufacturer's name or trademark.
2. Nominal size.
3. Type of plastic pipe (i.e., PE 3408).
4. Standard dimension ratio SDR 11.
5. ASTM D2513.
6. Extrusion date, lot number or batch number.

2.03 SOURCE QUALITY CONTROL

- A. If manufacturer's test data inadequate or unavailable, OWNER reserves right to reject or require additional tests to satisfy material requirements. Costs of these tests shall be borne by CONTRACTOR.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Trench, backfill, and compact in accordance with Section 02221.

B. Heat Fusion of Pipe:

1. Weld in accordance with manufacturer's recommendation for butt fusion methods. Provide qualified fusion operators.
2. Butt fusion equipment for joining procedures shall be capable of meeting conditions recommended by pipe manufacturer including, but not limited to, temperature requirements, alignment, and fusion pressures.
3. For cleaning pipe ends, solutions such as detergents and solvents, when required, shall be used in accordance with manufacturer's recommendations.
4. Do not bend pipe to greater degree than minimum radius recommended by manufacturer for type and grade.
5. Do not subject pipe to strains that will overstress or buckle piping or impose excessive stress on joints.
6. Branch saddle fusions shall be joined in accordance with manufacturer's recommendations and procedures. Branch saddle fusion equipment shall be of size to facilitate saddle fusion within trench.
7. Before butt fusing pipe, inspect each length for presence of dirt, sand, mud, shavings, and other debris or animals. Remove debris from pipe.
8. Cover at end of each working day open ends of fused pipe. Cap to prevent entry by animals or debris.
9. Use compatible fusion techniques when polyethylene of different melt indexes are fused together. Refer to manufacturer's specifications for compatible fusion.

C. Flange Jointing:

1. Use on flanged pipe connection sections.
2. Connect slip-on carbon steel backup flanges with nuts and bolts. Convuluted ductile iron backup rings may be substituted for joining HDPE pipes per manufacturer's recommendations.
3. Butt fuse fabricated flange adapters to pipe.
4. Observe following precautions in connection of flange joints.
 - a. Align flanges or flange/valve connections to provide tight seal. Require nitrile-butadiene (hycar for petroleum applications) gaskets if needed to achieve seal. Gaskets are required for flange/valve connections.

- b. Place U.S. Standard round washers as may be required on some flanges in accordance with manufacturer's recommendations. Bolts shall be lubricated in accordance with manufacturer's recommendations.
 - c. Tighten flange bolts in sequence and accordance with manufacturer's recommendations. Do not over-torque bolts.
- 5. Pull bolt down by degrees to uniform torque in accordance with manufacturer's recommendations.
 - 6. Protect below grade bolts with Tapecoat mastic and tape.

D. Pipe Placement:

- 1. Grade control equipment shall maintain design grades and slopes during installation of pipe.
- 2. Dewatering: Remove standing water in trench before pipe installation.
- 3. Unless otherwise specifically stated, install pipe in accordance with manufacturer's recommendations.
- 4. Maximum lengths of fused pipe to be handled as one section shall be placed according to manufacturer's recommendations as to pipe size, pipe SDR, and topography so as not to cause excessive gouging or surface abrasion; but not to exceed 400 ft.
- 5. Cap pipe sections longer than single joint (usually 40 ft) on both ends during placement except during fusing operations.
- 6. Prevent migration of dirt and debris through perforations during placement. Remove dirt or debris from pipe before backfilling.
- 7. Notify ENGINEER prior to installing pipe into trench and allow time for ENGINEER'S inspection. Correct irregularities found during inspection.
- 8. Complete tie-ins within trench whenever possible to prevent overstressed connections.
- 9. Complete flanged branch saddle connections within trench.
- 10. Allow pipe sufficient time to adjust to trench temperature prior to testing, segment tie-ins or backfilling activity.
- 11. Install reducers adjacent to laterals and tees.
- 12. To reduce branch saddle stress, install saddles at slope equal to and continuous with lateral piping.
- 13. Place in trench by allowing minimum 12 in./100 ft for thermal contraction and expansion.
- 14. Coordinate construction of header lines near access roads with OWNER to limit impediment of normal landfill operations.

E. Structure Penetration:

- 1. Provide manufactured or fabricated fittings for wall penetrations which have been designed for use with pre-cast modular mechanical seal.

3.02 FIELD QUALITY CONTROL

A. Pipe may be rejected for failure to conform to Specifications or following.

- 1. Fractures or cracks passing through pipe wall, except single crack not exceeding 2 in. in length at either end of pipe which could be cut off and discarded. Pipes within one shipment shall be rejected if defects exist in more than 5% of shipment or delivery.
- 2. Cracks sufficient to impair strength, durability or serviceability of pipe.
- 3. Defects indicating improper proportioning, mixing, and molding.
- 4. Damaged ends, where such damage prevents making satisfactory joint.

B. Acceptance of fittings, stubs or other specially fabricated pipe sections shall be based on visual inspection at Project site and documentation of conformance to these Contract Documents.

C. Pipe Testing: Comply with Section 01669.

3.03 PIPE IDENTIFICATION

A. Provide following for identification of underground header.

1. Pipeline signs shall consist of 9-in. by 12-in. metal sign connected to steel fence post with 2 U-bolts. Provide signs with wording "Force Main Pipe Location".
2. Place signs above and along pipeline route at key locations, such as tees, lateral connections, drip leg or tank risers, breaks in grade or horizontal alignment, and buried flanged or capped ends.

* * * END OF SECTION * * *

SECTION 15103
BUTTERFLY VALVES

PART 1 GENERAL

1.01 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A36-89 - Standard Specification for Structural Steel.
2. ASTM A48-83 - Standard Specification for Gray Iron Castings.
3. ASTM A126-84 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
4. ASTM A436-84 - Standard Specification for Austenitic Gray Iron Castings.
5. ASTM A536-84 - Standard Specification for Ductile Iron Castings.
6. ASTM D429-81 - Standard Test Methods for Rubber Property - Adhesion to Rigid Substrates.

B. American National Standards Institute (ANSI):

1. ANSI A21.11-80 - Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
2. ANSI B1.20.1-83 - Pipe Threads, General Purpose (INCH).
3. ANSI B16.1-89 - Cast Iron Pipe Flanges and Flanged Fittings.

C. American Water Works Association (AWWA):

1. AWWA C504-87 - Standard for Rubber-Seated Butterfly Valves.

D. National Electrical Manufacturers Association (NEMA):

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide bubble-tight at rated pressures with flow in either direction.
2. Satisfactory for applications involving frequent operation and applications involving valve operation after long periods of inactivity.
3. Except as modified or supplemented herein, conform butterfly valves including operators, to requirements of AWWA C504, latest edition.
4. Method for calculating torques for valve operators shall be as outlined in AWWA C504, Appendix A.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit in accordance with Section 01340.

B. Operation and Maintenance (O&M) Data:

1. Submit in accordance with Section 01730.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Allis Chalmers Corporation.
- B. American Darling.
- C. B.I.F.
- D. Henry Pratt Company.
- E. Kennedy Valve.

2.02 BUTTERFLY VALVES

A. General:

- 1. Proportion parts of valve for stresses occurring during continuous operation, and additional stresses occurring during fabrication or erection.
- 2. Provide tight-closing, rubber seat type with seats fastened to valve body or valve disk.

B. Valve Bodies:

- 1. Valves shall be short bodied pattern. Wafer design valves shall only be acceptable for air piping.
- 2. Cast Iron: ASTM A126, Class B or ASTM A48, Class 40.
- 3. Face and Drill Flange Valves: ANSI B16.1, Class 125 standard.
- 4. Mechanical Joint and Bell Ends: ANSI A21.11 standard.
- 5. Threaded Ends: ANSI B1.20.1 NPT standard. Integrate 2 trunnions for shaft bearings with each valve body.

C. Valve Shafts: Type 304 stainless steel.

D. Valve Seats:

- 1. Neoprene, or Buna N rubber.
- 2. Replaceable valve seats.
- 3. No. 18-8 stainless steel mating seat surfaces.
- 4. Valve Seat in-Place: ASTM D429, Method A or B.
- 5. Do not use metal to metal.

E. Valve Discs:

- 1. Valve Sizes Through 48 in.:
 - a. Cast iron: ASTM A48, Class 40.
 - b. Ductile iron: ASTM A536, Grade 65-45-12.
 - c. Alloy cast iron: ASTM A436, Type 1.
- 2. Attach to valve shaft with No. 18-8 stainless steel taper pins.
- 3. Valve discs that seat at angle to axis of pipe line other than 90 degrees not accepted.
- 4. Valve discs shall rotate 90 degrees from full open position to tight shut position.
- 5. For odorous air service valves, valve discs for valves 2 in. through 20 in. shall be Type 316 stainless steel.

F. Valve Bearings:

1. Sleeve type, self-lubricating, corrosion resistant, bronze, woven, oriented teflon or nylon.
2. Bearing load shall not exceed 1/5 of compressive strength of bearing or shaft material.
3. Valve bearings for odorous air service valves shall be teflon coated stainless steel.

G. Valve Shaft Seals:

1. O-ring contained in removable corrosion-resistant cartridges.

2.03 VALVE OPERATORS

A. Valve Boxes:

1. 3-piece assembly.
2. Provide 5-1/4-in. valve box dia.
3. Construct box and cover of cast iron in accordance with ASTM A48, Class B.
4. Provide valve with extended stem.
5. Stop stem 12 in. below box cover.
6. Provide one 4-ft long tee wrench for operating valve.

B. Manual Valve Operators:

1. Provide lever, tee wrenches, extension stems, and valve boxes as indicated on Drawings.
2. 2-piece adjustable screw type valve boxes.
3. Actuator:
 - a. Lever actuator.
 - b. Support actuator shaft and quadrant on permanently lubricated bronze bearings.
 - c. Actuators shall indicate valve position and provide adjustable stop to set closing torque.
 - d. Furnish removable operator lever with each valve specified with lever actuator.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment in accordance with manufacturer's written instructions and approved submittals.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Service:

1. Supplier's or manufacturer's technician for equipment specified herein shall be available at job site during system startup should problems arise.
2. Supplier or manufacturer shall direct services to specific system and equipment operation, maintenance, and troubleshooting. Process design and philosophy will be presented by ENGINEER. See Section 01600.

* * * END OF SECTION * * *

1. Supplier or manufacturer shall direct services to specific system and equipment operation, maintenance, and troubleshooting. Design and philosophy will be presented by ENGINEER. See Section 01600.

* * * END OF SECTION * * *

**SECTION 15122
AIR RELIEF VALVE**

PART 1 GENERAL

1.01 REFERENCES

1. American Society for Testing and Materials (ASTM):
 - a. ASTM A126-84 - Standard Specification for Grey Iron Castings for Valves, Flanges, and Pipe Fitting.
 - b. ASTM A240- REV B-89 - Standard Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate and Strip for Pressure Vessels.

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. Design valve to exhaust air from well pump column piping upon pump startup, and allow air to re-enter column piping when pump shut down.
2. During pump startup, valve shall release air from piping system, and close watertight when water enters valve and air exhausted. When pump shut down, valve shall open and allow air to re-enter piping system.
3. Design components for stresses occurring during continuous operation and additional stresses occurring during fabrication or erection.

1.03 SUBMITTALS

A. Product Data:

1. Submit in accordance with Section 01340.

B. Operation and Maintenance (O&M) Data:

1. Submit in accordance with Section 01730.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. APCO Model 142 WD.
- B. Or equal.

2.02 VALVE

- A. Provide one, 1-in. air relief valve with throttling device.
- B. Cast iron body, cover, and baffle.
- C. Stainless steel float, center guided for positive sealing.
- D. Equip with adjustable throttling device to regulate flow of air escaping during pump startup.

- E. Valve designed specifically for air relief from deep well pump discharge line.

2.03 COATING

- A. Shop and field coat valve exterior in accordance with Section 09805.

- 1. Color to match adjacent piping.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment in accordance with manufacturer's instructions and approved submittals.
- B. Install on pump discharge piping at location shown on Drawings. Attach using threaded connection tapped into discharge piping.
- C. Install 1 in. threaded galvanized steel piping from valve to point of discharge as shown on Drawings. Support valve discharge piping and slope to drain. Terminate valve discharge piping minimum of 24 in. above pump room floor.

3.02 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services:
 - 1. Supplier's or manufacturer's technician for equipment specified herein shall be available at job site for minimum of ½ manday, travel time excluded, trouble shooting system if problems arise.

* * * END OF SECTION * * *

DIVISION 16 - ELECTRICAL

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Electrical wire connectors, and splices for branch circuits and feeders.
2. Supporting devices for electrical components.
3. Electrical identification.

1.02 SUBMITTALS

A. Product Data:

1. Submit each type of product specified.

B. Shop Drawings:

1. Detail fabrication and installation of supports and anchorage for electrical items.

C. Submit in accordance with Section 01340.

1.03 QUALITY ASSURANCE

A. Comply with NFPA 70 for components and installation.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. Terms "Listed and Labeled": As defined in National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 PRODUCTS

2.01 ELECTRICAL WIRE

- A. Description: Single conductor, copper. Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.
- B. Thermoplastic Insulated Wire: Conform to NEMA WC 5.
- C. Cross Linked, Polyethylene Insulated Wire: Conform to NEMA WC 7.
- D. Connectors and Splices: Units of size, impeached rating, material, type, and class suitable for service indicated. Select to comply with Project's installation requirements.

2.02 SUPPORTING DEVICES

- A. Channel and angle support systems, hangers, anchors, sleeves, brackets, fabricated items, and fasteners are designed to provide secure support from building structure for electrical components.

1. Material: Steel, except as otherwise indicated, protected from corrosion with zinc coating or with treatment of equivalent corrosion resistance using approved alternative finish or inherent material characteristics.
2. Metal Items for Use Outdoors or in Damp Locations: Hot dip galvanized steel, except as otherwise indicated.

B. Steel channel supports have 9/16 in. diameter holes at maximum of 8 in. o.c., in at least 1 surface.

1. Fittings and accessories mate and match with channels and are from same manufacturer.

C. Nonmetallic Channel and Angle Systems: Structural grade, factory formed, fiberglass resin channels and angles with 9/16 in. diameter holes at maximum of 8 in. o.c., in at least 1 surface.

1. Fittings and accessories mate and match with channels or angles and are from same manufacturer.
2. Fitting and Accessory Material: Same as channels and angles, except metal items may be stainless steel.

D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps or "click" type hangers.

E. Sheet Metal Sleeves: 0.0276 in. or heavier galvanized sheet steel, round tube, closed with welded longitudinal joint.

F. Pipe Sleeves: ASTM 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

G. Cable Supports for Vertical Conduit: Factory fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable iron casting with hot dip galvanized finish.

H. Expansion Anchors: Carbon steel wedge or sleeve type.

I. Toggle Bolts: Steel springhead type.

J. Powder Driven Threaded Studs: Heat treated steel.

2.03 ELECTRICAL IDENTIFICATION

A. Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Cable Labels: Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.

1. Type: Preprinted, flexible, self adhesive, vinyl. Legend is overlaminated with clear, weather and chemical resistant coating.
2. Color: Black legend on orange field.
3. Legend: Indicates voltage.

C. Colored Adhesive Marking Tape for Wires: Self adhesive vinyl tape not less than 3 mils thick by 1 in. wide.

- D. Underground Line Warning Tape: Permanent, bright colored, continuous printed, vinyl tape with following features:
 - 1. Size: Not less than 4 mils thick by 6 in. wide.
 - a. Compounded for permanent direct burial service.
 - 2. Embedded continuous metallic strip or core.
 - a. Printed Legend: Indicates type of underground line.
- E. Tape Markers: Vinyl or vinyl cloth, self adhesive, wraparound type with preprinted numbers and letters.
- F. Color Coding Cable Ties: Type 6/6 nylon, self locking type. Colors to suit coding scheme.
- G. Engraved, Plastic Laminated Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched for mechanical fasteners 1/16 in. minimum thick for signs up to 20 sq. in. 1/8 in. thick for larger sizes. Engraved legend in black letters on white face.
- H. Interior Warning and Caution Signs: Preprinted, aluminum, baked enamel finish signs, punched for fasteners, with colors, legend, and size appropriate to application.
- I. Exterior Warning and Caution Signs: Weather resistant, nonfading, preprinted, cellulose acetate butyrate signs with 0.0396 in. galvanized steel backing, with colors, legend, and size appropriate to application. 1/4 in. grommets in corners for mounting.
- J. Fasteners for Plastic Laminated and Metal Signs: Self tapping stainless steel screws or No. 10/32 stainless steel machine screws with nuts and flat and lock washers.

2.04 TOUCHUP PAINT

- A. For Equipment: Provided by equipment manufacturer and selected to match equipment finish.
- B. For Nonequipment Surfaces: Matching type and color of undamaged, existing adjacent finish.
- C. For Galvanized Surfaces: Zinc rich paint recommended by item manufacturer.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION REQUIREMENTS

- A. Install items level, plumb, and parallel and perpendicular to other components, except where otherwise indicated.
- B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- C. Give right-of-way to piping systems installed at required slope.

3.02 WIRING METHODS

- A. Feeders: Type XHHW, copper conductor, in raceway, except as otherwise indicated.
- B. Underground Feeders: Type XHHW, copper conductor, 90C insulation, in raceway, except as otherwise indicated.
- C. Branch Circuits: Type THHN/THWN.
- D. Class 2 and Class 3 Control Circuits: Type THHN/THWN.

3.03 ELECTRICAL SUPPORTING METHODS

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click type clamp system.
- D. Conform to manufacturer's recommendations for selecting supports.
- E. Strength of Supports: Adequate to carry loads times safety factor of at least 4. Min. load of 200 lb.

3.04 INSTALLATION

- A. Install wires according to manufacturer's written instructions and NECA's "Standard of Installation."
- B. Conductor Splices: Keep to minimum and comply with following:
 - 1. Install splices and taps that are equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 2. Use splice and tap connectors that are compatible with conductor material.
- C. Wiring at Outlets: Install with at least 12 in. of slack conductor at each outlet.
- D. Connect outlets and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to UL 486A.
- E. Install devices to securely and permanently fasten and support electrical components.
- F. Miscellaneous Supports: Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices except where components are mounted directly to structural features of adequate strength.
- G. Fastening: Unless otherwise indicated, securely fasten electrical items and their supporting hardware to manholes. Perform fastening according to following:
 - 1. Means of concrete inserts or expansion bolts on concrete or solid masonry.
 - 2. Threaded studs driven by powder charge and provided with lock washers and nuts may be used instead of expansion bolts, machine screws, or wood screws.
 - 3. Drill holes in concrete so holes more than 3/4 in. deep do not cut main reinforcing bars.
 - 4. Fill and seal holes drilled in concrete and not used with patching cement.
 - 5. Select fasteners so load applied to any fastener does not exceed 25% of proof test load.

H. Identification Devices:

1. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
2. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated on Contract Documents or required by codes and standards. Use consistent designations throughout Project.
3. Self-Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.
4. Identify cables of certain systems with color banding as follows:
 - a. Bands: Colored adhesive marking tape. Make each color band 2 in. wide, completely encircling conduit, and place adjacent bands of 2-color markings in contact, side by side.
 - b. Locate bands at changes in direction, at penetrations of walls and floors, at 50 foot maximum intervals in straight runs, and at 25 feet in congested areas.
 - c. Colors:
 - 1) Alarm System: Red.
 - 2) Control System: Blue and yellow.
 - 3) Telecommunications System: Green and yellow.
5. Tag or label power circuits for future connection and circuits and enclosures with other circuits. Identify source and circuit numbers in each cabinet, pull box, junction box, and outlet box. Color coding may be used for voltage and phase indication.
6. Identify Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above power and communication lines. Locate 12 in. below finished grade.
7. For panelboards, provide framed, typed circuit schedules with description and identification of items controlled by each individual breaker.

3.05 DEMOLITION

- A. Where electrical work to remain is damaged or disturbed in course of Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- B. Abandoned Work: Cut and remove buried wiring indicated to be abandoned in place, 2 in. below surface of adjacent construction. Cap and patch surface to match existing finish.
- C. Removal: Remove demolished material from Project site.

3.06 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill surfaces necessary for electrical installations.
- B. Repair disturbed surfaces to match adjacent undisturbed surfaces.

3.07 TOUCHUP PAINTING

- A. Clean damaged areas and provide prime, intermediate, and finish coat to match undamaged surfaces.
- B. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

* * * END OF SECTION * * *

**SECTION 16401
ELECTRIC SERVICE**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Electric Utility: Cincinnati Gas & Electric Company (CG&E).

1.02 QUALITY ASSURANCE

- A. Regulatory Requirements:

- 1. National Fire Protection Association (NFPA):
 - a. NFPA No. 70-93 - National Electrical Code (NEC).

1.03 SUBMITTALS

- A. Product Data:

- 1. Data sheets and conduit descriptions.
- 2. Submit in accordance with Section 01340.

PART 2 PRODUCTS

2.01 ELECTRIC SERVICE

- A. Electric Service Characteristics:

- 1. As indicated on Drawings and provided by Electric Utility.

PART 3 EXECUTION

3.01 PREPARATION

- A. Confirmation of Electric Service:

- 1. Consult with Electric Utility to verify service information specified and shown on Drawings.
- 2. Include deviations required by Electric Utility from contract documents to comply with Electric Utility standards and requirements.

- B. Metering:

- 1. Consult with Electric Utility regarding service entrance requirements and metering equipment.
- 2. Install metering equipment and empty conduit for metering conductors to meet standards and requirements of Electric Utility.

- C. Electric Utility Charges:

- 1. Electric Utility charges for extension distribution system to point of service termination will be paid by OWNER.

D. Application for Electric Service.

1. Obtain required forms from Electric Utility.
2. Assist OWNER in completion of forms and deliver completed forms to Electric Utility.
3. Coordinate schedule for installation of electric service with Electric Utility.

3.02 INSTALLATION OF EXTENDED UNDERGROUND ELECTRIC SERVICE

- A. Contact Ohio Utilities Protection Service (800) 362-2764 before digging.
- B. Coordinate with CG&E before digging to confirm proper installation of service.
- C. Install electric service as shown on Drawings.

* * * END OF SECTION * * *

SECTION 16743
TELEPHONE SERVICE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Trench excavation and backfill.
2. PVC conduit.

B. Related Sections:

1. General Earth fill - Section 02247.
2. Trenching, Backfilling, and Compaction - Section 02221.
3. Restoration - Section 02984.

1.02 DEFINITIONS

- A. Telephone Utility: Cincinnati Bell Telephone.

1.03 SUBMITTALS

A. Product Data:

1. Data sheets and conduit descriptions.

- B. Submit in accordance with Section 01340.

1.04 QUALITY ASSURANCE

- A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with NFPA 70.
2. Federal Communications Commission (FCC):
 - a. FCC-CFR Title 47, Part 68 - Connection of Terminal Equipment to Telephone Network.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Do not install damaged equipment.

- B. Store equipment in clean, dry space and protect from dirt, fumes, water, construction debris, and physical damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Polypipe Industries, Gainesville, Texas, (or approved equal).
- B. Phillips Driscopipe, Inc., Richardson, Texas, (or approved equal).

2.02 GENERAL

- A. Accommodate double line sets, with 1 conduit path.
- B. Comply with FCC Rules, Part 68.
 - 1. Registered with FCC.
 - 2. Manufacturer's affidavit on file with FCC.
- C. Provide lightning protection.
- D. Environmental:
 - 1. Operating temperature range: 0°C to 60°C.
 - 2. Relative humidity to 90%.

2.03 SERVICE ENTRANCE

- A. Telephone service as provided by Cincinnati Bell Telephone and meeting requirements of this Specification.
- B. 4 in. conduit for service extended from existing termination box to control panel.
- C. Telephone terminal cabinet.
- D. 4 ft wide by 4 ft high by 3/4 in. plywood mounting panel painted gray on all sides.

PART 3 EXECUTION

3.01 PREPARATION

- A. Confirmation of Telephone Service:
 - 1. Consult with Telephone Utility to verify service information specified herein and shown on Drawings before submitting Bid. Include in Base Bid price, deviations required by Telephone Utility from Drawings and Specifications.
- B. Telephone Utility Charges:
 - 1. Include in Base Bid price, Telephone Utility charges for extension of telephone distribution system service and providing termination equipment.

3.02 EXAMINATION

- A. Examine areas and conditions under which telephone system to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of Work.

3.03 INSTALLATION

- A. Contact Ohio Utilities Protection Service before digging (800) 362-2764.
- B. Coordinate with telephone utility before digging to confirm proper installation of service.
- C. CONTRACTOR is responsible for supplying 4-in.-dia. PVC conduit for telephone service extending from existing termination box to control panel.
- D. Excavate trench from existing telephone service termination box location to existing electrical service termination location as shown on Drawings.
- E. Excavate trench from existing electrical service termination location to new service termination location as shown on Drawings.
- F. Stockpile excavated soil in clean, dry area on site as designated by Project Manager.
- G. Provide pull boxes along length of trench at 500-ft intervals.
- H. Backfill trench with stockpiled excavated soil and general earth fill as shown on Drawings.
- I. Install concrete layer in trench as shown on Drawings.

3.04 RESTORATION

- A. Restore trench area to condition equal to existing condition prior to construction.
- B. Comply with Section 02984 Restoration.

3.05 ADJUSTMENT AND CLEANING

- A. Clean service termination and enclosures of dirt and debris.

* * * END OF SECTION * * *

SECTION 16744
UTILITY POLE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Hole excavation.
2. Pole installation.

1.02 DEFINITIONS

- A. Structures and Surface Features: Existing structures and surface features including buildings, pavements, curb and gutter, signs, posts, fences, trees, shrubs, landscaped surface features, and other miscellaneous items.
- B. Utilities: Existing gas mains, water mains, steam lines, electric lines and conduits, telephone and other communication lines and conduits, sewer pipe, cable television, other utilities and appurtenances.
- C. Clearing and Grubbing: Cutting and disposing of trees, brush, windfalls, logs, and other vegetation, and removing and disposing of roots, stumps, stubs, grubs, logs, and other timber.

1.03 PROJECT/SITE CONDITIONS

- A. Notify corporations including the Ohio Utilities Protection Service (OUPS), companies, individuals or authorities owning above or below conduits, wires, pipes or other utilities running to property or encountered during excavating activities.
- B. Protect, support, and maintain conduits, wires, pipes or other utilities that are to remain in accordance with requirements of owners of said services.
- C. Do not block or obstruct roads, streets, or driveways with excavated or grubbed materials, except as authorized by owner.

1.04 MEASUREMENT AND PAYMENT

- A. The Construction drawings will indicate the area that is to be prepared. The area on the plans is approximate only. No claims will be allowed for any increase over the estimated area of Site Preparation unless work is performed outside the area shown on the project plans, and then only when such work is caused by a change in the plans approved, in writing, by the OWNER.
- B. The final pay quantity of site preparation and hole excavation will be measured as a lump sum.
- C. The final pay quantity for the purchase of any utility poles will be measured on a unit price basis.

1.05 REFERENCES

- A. Butler County Department of Building and Zoning.
- B. Cincinnati Gas & Electric Company.
- C. Cincinnati Bell Telephone.

PART 2 PRODUCTS

2.01 UTILITY POLE

- A. Secondary Utility pole free of termites, splitting, and any condition detrimental to the service life of the pole supplied by the CONTRACTOR.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Clear and grub to provide access to excavation area and to provide a clean area for utility pole storage.
- B. Excavate an adequate hole to prevent toppling of pole 75-ft from existing utility pole labeled 67BT-62E and stockpile excavated soil in a clean, dry area next to the hole.
- C. Store utility pole on site next to the hole.
- D. Contact an Electrical Inspector at Butler County Department of Building and Zoning.
- E. Upon approval of the hole and pole, securely anchor and install the utility pole to provide adequate stability for utility services to be connected. Take care not to damage any surrounding utilities.
- F. Backfill around the utility pole with the stockpiled excavated soil.

* * * END SECTION * * *

SECTION 16900
INSTRUMENTATION AND CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. The extension of the electrical service from the meter at the west end of the trench to the three extraction wells, and the flow metering and sampling vault.
2. Connection of power to the pumps with two means of turning the pumps on:
 - a. Automatically with the level controls in the extraction well
 - b. Manually at the extraction well manhole
3. Connection of power to the flow meter and the sampling equipment housed in the flow metering and sampling vault.
4. Control wiring that provides an alarm when the level of liquid in the extraction well/trench exceed either the high level condition or the low level condition. The alarm shall distinguish whether it is a high level alarm or low level alarm.
5. A pump run timer that provides a readout of the accumulative run time for each pump.
6. A central control panel that contains alarm indicators for each extraction well/pump, a pump "on" indicator for each pump, an auto dialer for notifying parties of an alarm condition, and any heating equipment required to protect the equipment housed in the panel.
7. Connection of the telephone lines to the auto dialer equipment.
8. Testing all electrical and control components

1.02 REFERENCES

- A. Institute of Electrical and Electronic Engineers, Inc. (IEEE):
 1. IEEE C62.41-91 - IEEE Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits.
- B. Instrument Society of America (ISA).
- C. National Electrical Manufacturer's Association (NEMA).
- D. National Fire Protection Association (NFPA):
 1. NFPA No. 70-90 - National Electrical Code (NEC).
- E. Underwriters Laboratories, Inc.:
 1. UL 508-93 - Safety Industrial Control Equipment.

1.03 SYSTEM DESCRIPTION

A. Pumps

1. The pumps will be turned on automatically when the liquid level in the extraction well/trench reaches the high level/pump on level. The pump will operate until the liquid level reaches the low level/pump off level. The pump will operate in this cycle as the liquid level in the extraction well/trench rises and is pumped out.

B. Controls

1. In the event of a failure in the system, the pump could fail to be turned on when the high level/pump on level is reached. A second level indicator is set above the high level/pump on level. This indicator is a high level alarm. When the liquid rises to this level, an alarm condition exists. As an indication of the condition, an annunciator will indicate a high level alarm condition at a panel within the extraction well manhole. Additionally a signal will be sent to the central control panel indicating what alarm condition exists. An annunciator will signal the alarm at the central panel. Additionally, the auto dialer will be signaled to make a call to the on call maintenance person. The call will indicate: that an alarm condition exists, the time the alarm was signaled, the location of the alarm condition, and the condition at the extraction well.
2. The auto dialer will be programed to call up to 4 people (Phone numbers) until an acceptable acknowledgment (code) is received. The time between successive calls in a 4 number series will be 5 minutes between individual calls. The time between series of calls will be 15 minutes. The dialer will continue cycling through the numbers until an acknowledgment is received. The auto dialer system will allow for an incoming call to signal that the alarm notice has been received.
3. After a alarm notice is acknowledged, the system will remain silent for two hours. If the alarm system is not turned off manually at the central panel, a new series of alarm calls will be initiated.
4. A similar series of events will occur for a low level alarm condition.

1.04 SUBMITTALS

A. With Bid/Proposal

1. The contractor shall submit system descriptions and references for at least 5 similar systems in the past 3 years.
2. A listing of the equipment and the equipment manufacturer to be used in the application.
3. A statement that the manufactured items identified have been used in similar applications and references at the operation.
4. The contractor shall submit licenses required to perform the described work in the State of Ohio and Butler County.
5. The contractor shall submit a statement and supporting drawings identifying the number, size and location of the conduits required for the project.

B. Prior to Installation

1. Submit the required permit applications for the system
2. Provide system diagrams for the system

C. After construction/prior to final acceptance

1. A complete operations and maintenance manual
2. A statement that the system has been tested and complies with these specifications.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Manufacturer

- a. The manufacturer will provide statements that they understand the requirements of ^{the} application where the equipment is being ~~applied~~ ^{used} and will warrant the equipment for the full warrantee period.
- b. Additionally, the manufacturer shall provide evidence of systems in similar environments being in place for at least five years.

2. The Proposer

- a. The company submitting the proposal shall demonstrate at least five years experience in the industry and with similar project experience. Additionally, the proposer shall demonstrate financial strength.

3. Installer

- a. The installer shall provide evidence of at least five similar installations preformed by the installer in the past three years.

1.06 PROJECT/SITE CONDITIONS

A. Site

1. The project site is a closed landfill site that will be vacant/unstaffed for the majority of the time. There will be no buildings or other environmentally controlled areas in which to house the equipment or control panels. The individual control panels will be separated by approximately 300-400 horizontal feet.

B. Project

1. The system that the electrical and instrumentation and control wiring and equipment will be connected with will be the ground water extraction and conveyance system for a superfund site. As such the equipment that comes in contact with the liquid will be exposed to high to moderate levels of iron. Additionally, the above-ground or at-grade equipment will be susceptible to the full range of temperatures and humidity that southwestern Ohio usually experiences.
2. Though not anticipated, the equipment shall be resistant to vandals as the area is some what remote.

1.07 SEQUENCING AND SCHEDULE

A. Sequencing

1. The construction/ installation of the system shall proceed in such a manner as to avoid damage to the materials and equipment in place. Additionally, the sequencing shall be such that all aspects of the system can be installed without damaging other parts of the system or without presenting a potential of harm to human health and safety.

B. Schedule

1. The construction shall proceed in accordance with the schedule developed for the project. The contractor shall take into consideration the anticipated weather conditions when planning the work, such that the work is completed on time and not delayed due to weather.

1.08 WARRANTY/GUARANTY

1. The Installer shall provide a written guarantee that the system shall function as defined in these specifications and any addenda to these specifications for a period of three years after acceptance of the system by the owner(s). As added assurance of this successful operation, the installer shall provide a "performance" bond for the full three year period.
2. The Installer, in conjunction with the manufacturer, shall provide a warranty for the equipment provided as part of the system. The warranty shall warrant any equipment against failure and or malfunction for a period of three years.

1.09 MAINTENANCE

1. Maintenance Service

The installer shall be responsible for the maintenance of the system for the period of six months after the owner has accepted the system. The maintenance will include the repair, replacement or adjustment of any components that fail to function properly during the period.

2. Extra Stock and Materials

The installer shall provide the following extra parts as part of the contract.

- 1 pump
- 1 set of level indicators and controls
- 1 pump run timer

PART 2 PRODUCTS

2.01 SYSTEM PERFORMANCE

A. Attributes

1. Requirements

- a. The system shall operate without the assistance of an operator.
- b. The system shall be self monitoring for operation within an accepted range.
- c. Operation beyond these ranges, by a predetermined amount, shall trigger notification of the system being out of compliance with the design standards.
- d. The system shall be powered and controlled such that any one of the extraction well pumps may be taken out of service and the other extraction wells still function.
- e. Each pump can be operated manually from the main control panel and each pump can be operated locally at the main control panel.

B. Criteria

1. The system shall pump groundwater at the minimum rate of 25 GPM from each extraction well regardless of the number of pumps operating.
2. If an alarm condition exists, a phone call message will be sent to up to four people.

3. The system will operate to keep a maximum of five feet of liquid in the trench, above the sump, and will shut off at one foot of liquid in the trench.
4. Alarm conditions will be indicated when the liquid level in the trench exceeds the pump on level by two feet, and when the level in the trench is at zero (three feet of liquid in the sump).

PART 3 EXECUTION

3.01 PREPARATION

1. The contractor shall not initiate work on the installation of materials until the materials have been inspected for damage by the contractor.

3.02 GENERAL

1. Install in accordance with the manufacturer's approved product installation procedures
2. Install in accordance with all codes and regulations

3.03 TESTING/DEMONSTRATION

1. The contractor will be responsible to test the system in all operation modes to verify the performance of the system.
2. The contractor will perform up to one day of training for the implementer's representative(s).

3.04 SPARE PARTS

1. The contractor will provide and test spare parts prior to turning the parts over to the implementer's representative.

3.05 OPERATION AND MAINTENANCE MANUAL

1. The contractor will provide an Operation and Maintenance manual for the system that will include but not be limited to:
 - a. Equipment catalogue sheets
 - b. System operation description
 - c. As built wiring diagrams
 - d. As built control panel drawings, and
 - e. Other pertinent information as will be required to operate and maintain the system.

* * * END OF SECTION * * *

SECTION 16910
MAIN INSTRUMENT PANEL

PART 1 GENERAL

1.01 SUMMARY

- A. Items specified in this section shall conform to general requirements of Section 16900.

PART 2 PRODUCTS

2.01 INSTRUMENTATION AND CONTROL (I&C) EQUIPMENT

- A. Equipment provided in this section shall conform to following.
 - 1. I&C Panel Construction: Section 16930.
 - 2. Miniature Electronic Panel Instruments: Section 16931.
 - 3. Miniature Electronic Panel Instrument Accessories: Section 16932.
 - 4. Annunciators: Section 16933.
 - 5. Graphic Panels: Section 16934.
 - 6. Telephone Automatic Dialer System: Section 16935.
 - 7. Pilot and Miscellaneous Control Devices: Section 16936.
 - 8. Electronic Circular Chart Recorder: Section 16937.
 - 9. Data Acquisition System: Section 16939.

2.02 PANEL AND ENCLOSURE

- A. Free-standing and totally enclosed cubicle type as shown on Drawings and specified in Section 16930 with graphic and indicating and control devices mounted flush on solid front face.
- B. Panel shall have rear access doors and other features as specified.
- C. Dimensions: Approximately 3 ft wide by 90 in. high by 30 in. deep.
- D. Mount and wire instruments and other necessary equipment to terminal connections within panel so installation shall require only setting panel in place and making necessary connections to field wiring and utilities.
- E. Right-hand section shall be graphic display.
- F. Left-hand section shall contain analog monitoring and control, digital monitoring, and control equipment.

2.03 ANNUNCIATOR PANEL

- A. Include annunciator (alarm) panel.
- B. Indications as follows.
 - 1. Light Off: System normal.
 - 2. Flashing Red Indicating Light: System in alarm condition.
 - 3. Steady red Indicating Light and Horn Silenced: Alarm acknowledged but not cleared.

- C. Provide following alarms.

Description	Interface
Groundwater Pump #1	Contact from level switch
Groundwater Pump #2	Contact from level switch
Groundwater Pump #3	Contact from level switch

2.04 ELECTRONIC PANEL INSTRUMENTS

- A. Provide following panel mounted monitoring equipment.

Designation	Description	Function/Device	Range
Timer	Groundwater Pump run time	Time of run-totaling	0 - 10,000 min

- B. Provide one internal panel mounted power supply (power to current analog) and accessories. Item specified in Section 16932.

2.05 MISCELLANEOUS PANEL CONTROLS

- A. Provide following front of panel mounted controls.

Designation	Description	Function/Device	Keypad
Dialer	Phone Dialer	Initiate phone call on alarm condition	Alternate phone number input 0 - 9

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install and wire in accordance with manufacturer's written instructions and approved submittals.

*** END OF SECTION ***

SECTION 16930
INSTRUMENT AND CONTROL PANEL CONSTRUCTION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Panel and enclosure requirements for instrumentation and control (I&C) system.

1.02 MAINTENANCE

A. Extra Materials:

1. Provide minimum of 5 or 10%, whichever greater, for each type of fuse used on Project.
2. Provide minimum of 30% spare terminals; to be shown as such on panel drawings.

PART 2 PRODUCTS

2.01 CONTROL PANELS

- A. Factory-fabricate, install instruments, plumb and wire in factory.
- B. Make external connections by way of numbered terminal blocks.
- C. Conform to ISA standards.

2.02 FREE-STANDING PANEL CONSTRUCTION

- A. Construct panels to external dimensions as shown on Drawings. Instrument arrangement shall be as described, with minor modifications as required by particular equipment furnished. Modifications subject to ENGINEER'S approval.
- B. Fabrication:
 1. Fabricate each panel from sheet steel with one-piece, 10 ga steel front and 14 ga steel sides, back, and top.
 - a. Construct panels so no seams or bolt heads visible when viewed from front.
 - b. Panel cutouts for instruments and other devices, such as lights and switches, shall be cut, punched or drilled, and smoothly finished with rounded edges.
 2. Provide steel angle stiffeners on back of panel face to prevent panel deflection under instrument loading or operation.
 3. Provide internal structural steel framework for instrument support purposes and panel bracing. Internal framework shall permit lifting of panel without racking or distortion.
 4. Provide removable lifting rings designed to facilitate rigging and lifting of panel during installation. Provide plugs to fill lifting ring holes after installation complete and lifting rings removed.

C. Doors:

1. Provide each panel with full height, fully gasketed access doors except on graphic sections and where otherwise specified.
2. Provide with 3-point key locking latches.
3. Rear access doors shall extend no further than 24 in. beyond panel when opened to 90-degree position.
4. Provide with full length, continuous, piano type stainless steel hinges and pins.

D. Lights:

1. Provide separately fused and switched 100 watt incandescent back-of-panel lights.
2. Provide one light for every 4 ft of panel width.
3. Mount inside and in top of back-of-panel area.

E. Electrical Service:

1. Provide 20 amp, 110 v service outlet circuit within back-of-panel area.
2. Provide 20 amp molded case circuit breaker with toggle operator to switch circuit on and off.
3. Provide separately fused 3-wire, 110 v, 15 amp duplex receptacles, one for every 4 ft of panel width, 2 minimum per panel, spaced evenly along back of panel area. If panel 4 ft wide or less, 1 receptacle required.

F. Temperature Control:

1. Design panels to permit continuous operation of mounted components therein with panel ambient temperatures of up to 50°C.
2. Provide louvers or forced ventilation as required to prevent temperature build-up due to electrical devices mounted in or on panel.
3. Mount stamped sheet metal louvers on top and bottom in rear of panels.
4. Provide separately fused forced ventilation fans, when required, with washable or replaceable filters. Fan motors shall operate on 110 v, 60 Hz power.
5. Equip panels mounted outside buildings with thermostatically controlled space heaters capable of maintaining internal temperature of 10°C, $\pm 2^\circ\text{C}$, with 20 mph wind at ambient temperature of -30°C. Heaters shall operate on 110 vac, 60 Hz power.

G. Instrument Location:

1. Locate instruments designated for back of panel mounting to allow for maintenance and adjustment.
2. Instrument mounting height shall not exceed 6 ft-6 in., minimum height shall be 4 ft-0 in.

H. Fusing:

1. Maximum Fuse Size: 5 amp.
2. Group instruments after separate fusing with maximum of 10 instruments/fuse.
3. Fuse power supplies individually.
4. Where 5 amp capacity exceeded by load requirements, provide additional fuses.
5. For field devices powered by panel, provide separate fuse for each output.

2.03 PANEL CONSTRUCTION FOR OTHER THAN FREE-STANDING

A. Enclosures shall conform to NEMA requirements as follows.

1. Inside Buildings: NEMA 12.
2. Outside Buildings and in Manholes: NEMA 4X.
3. Class I, Division 1 or 2 Areas: NEMA 7.

B. In addition to NEMA standards, conform to following requirements.

1. Minimum Metal Thickness: 14 ga.
2. Doors: rubber-gasketed with continuous hinge.
3. Wherever practical, enclosures shall be manufacturer's standard product.
4. Size to adequately dissipate heat generated by equipment mounted in or on panel.
5. Equip panels mounted outside buildings with thermostatically controlled space heaters capable of maintaining internal temperature of 10°C, $\pm 2^\circ\text{C}$, with 20 mph wind at ambient temperature of -30°C. Heaters shall operate on 110 vac, 60 Hz power.

2.04 STANDARD SIGNAL INTERFACES

A. Unless otherwise specified, discrete input and output signals shall conform to following.

1. Isolated unpowered (dry) contact closures.
2. Power contact from panel receiving signal or device receiving signal.

B. Unless otherwise specified, input and output analog signals shall conform to following.

1. 4-20 mAdc.
2. For 2-wire transmitter, provide isolated type and power with 24 or 48 vdc at panel or device receiving signal.
3. Where isolation required to interface with particular equipment supplied, provide necessary I/I converters.

2.05 PANEL FINISH

A. Remove mill scale, rust, grease, and oil. Fill imperfections and sand smooth.

B. Paint interior and exterior with one coat of epoxy coating metal primer, 2 finish coats of 2-component type epoxy enamel.

C. Sand surfaces lightly between coats.

D. Dry film thickness shall not be less than 3.0 mils.

E. Color: Selected by ENGINEER.

2.06 NAMEPLATES

A. Provide nameplates for I&C panels and each front-of-panel instrument and device with designations as shown on Drawings and as listed in Specifications.

B. Panel Designation: Engraved with ENGINEER'S panel tag number and description with 1/2 in. high characters.

- C. Application/Function Nameplate: Locate 3/16 in. characters above or near panel mounted instrument or device consisting of descriptive phrase using nomenclature as listed in Specifications (when available).
 - D. Tag Number: Include ENGINEER'S tag number as shown on P&IDs and in Specifications on each nameplate.
 - E. Laminated black plastic inscribed with white characters.
 - F. Provide aluminum decal with black 3/16 in. characters on top side at rear of instrument on or near each device on rear side of panel using tag number or device designation.
 - G. Secure front-of-panel and front-of-instrument nameplate with drive screws or self-tapping fasteners.
- 2.07 SOURCE QUALITY CONTROL
- A. Test wiring and plumbing prior to shipment.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install panels in locations indicated on Drawings and in accordance with manufacturer's written instructions and approved submittals.
- B. Touch up panel after installation.

* * * END OF SECTION * * *

SECTION 16935
TELEPHONE AUTOMATIC DIALER SYSTEM

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

A. Design Requirements:

1. Electronic system shall interface field system to public telephone system on preselected basis.
2. Upon receipt of one or more critical alarm trips, electronic system will automatically dial out onto public phone system (up to 4 specified telephone numbers) with preprogrammed messages.
3. System shall continue calling until call completed and acknowledged.
4. Upon acknowledgment, system will reset and hold for next alarm, or recall for same alarm if not resolved within field adjustable time span of 1 to 99 hrs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Kaye.
- B. Raco.
- C. Or equal.

2.02 DIALER

- A. Enclosure: NEMA 12, surface mount.
- B. Input: Normally closed contacts.
- C. Input Time Delay: 1 to 40 sec, adjustable.
- D. Remote Reset: Alarm acknowledged by either depressing touch-tone key or calling dialer back when alarm acknowledged from nontouch-tone telephone.
- E. Operating Temperature: 32°F to 160°F.
- F. Operating Humidity: 0% to 90%.
- G. Output: To standard phone line through integral FCC approved alarm coupler.
- H. Power: 120 vac, 60 Hz.
- I. Battery Backup: 4-hr including rechargeable battery and charger.
- J. Provide minimum of 4 separate input channels for capability of 4 separate messages.
- K. Provide lightning-surge protection on both power and telephone line input to dialer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's written instructions and approved submittals.
- B. Wire each device and test to be suitable for operation.
- C. Install in main control panel.

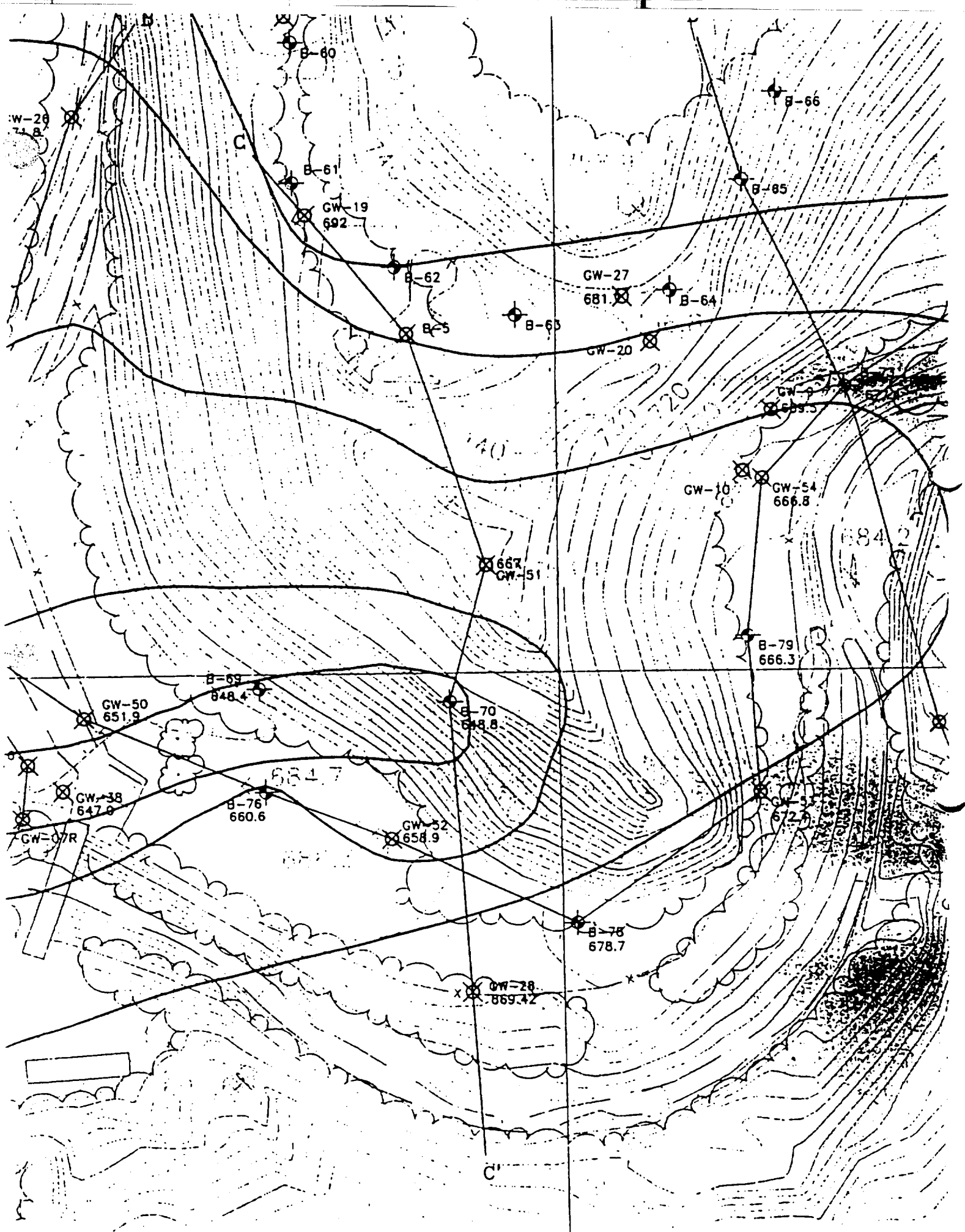
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APPENDIX

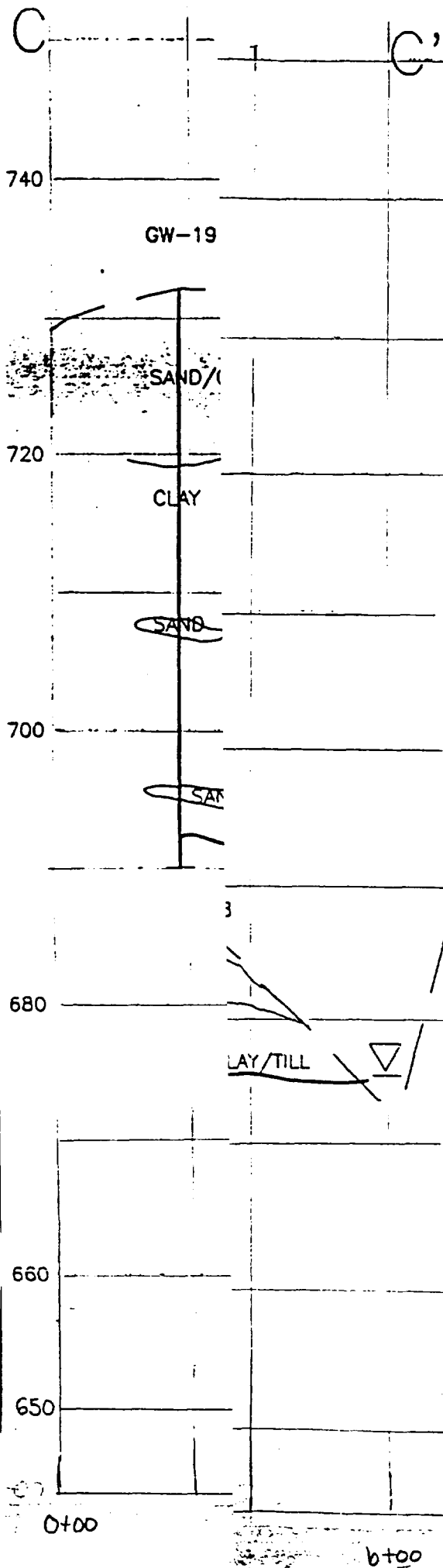
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APPENDIX I
SOIL BORING DATA



Plan View of C-C'



GENERAL ENFORCEMENT

DRILLING LOG

Page 1 of 2

State Ohio

Start Date July 20, 1982

Site Skinner Landfill

Completion Date July 20, 1982

Boring No. B-5

Ground El.

Drilling Firm ATEC

Groundwater El.

Type of Drill

at completion

Driller

after days

Geologist Micheal McCarrin

Total Depth of Boring 16.5'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks
	0	GROUND SURFACE			
	1	<u>Silty Sand, brown</u>	4/7/23	1	damp
	2				
	3	<u>Sandy Silty Clay, brown-tan</u>	4/6/6	2	moist
	4				
	5				
	6		3/5/4	3	moist
	7				
	8				
	9				
	10				

State OhioBoring No. B-5Site Skinner LandfillPage 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks
	11		2/4/5	4	very moist
	12				
	13				
	14				
	15				
	16	Shale, grey	7/13/ 15	5	wet
		End of Boring			
	17	Well Construction: - Screen set from 12.0 to 15.0 feet - Sand from 11.0 to 15.0 feet - Bentonite from 9.0 to 11.0 feet - Cement grout from 0.0 to 9.0 feet - Well protector casing - 2" PVC well casing - 3'-0.010" PVC screen			

DRILLING LOG

WELL NUMBER: 5L GW19 OWNER: U.S. EPA
 LOCATION: Near lagoon ADDRESS: Skinner Landfill
(southern well) West Chester, OH
 TOTAL DEPTH: 43.0'
 SURFACE ELEVATION: 731.51' WATER LEVEL: _____
 DRILLING COMPANY: Moore DRILLING METHOD: HSA coring DATE DRILLED: 5/20/86
 DRILLER: F Moore HELPER: Bill
 LOG BY: P Bartz

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
5-1	SS	4 7			Light brown and red medium to coarse sand and gravel grading to silty sand and gravel, some interbedded sandy, silty clay, loose to medium dense, moist (gp-gm, cl).
5-2	SS	11 4 10			
5-3	SS	15 12 2			
5-4	SS	13 17 33			
5-5	SS	10 16 16			
5-6	SS	16 16 20			13.0'
5-7	SS	12 12 15			Gray silty, sandy clay, some gravel, grading to clayey, gravelly silt, stiff to very stiff, moist to wet (cl-mi). Gravel and sand content increase with depth, contains some sand and clay layers.
5-8	SS	8 7 9			

DRILLING LOG

WELL NUMBER: SLGW19
 LOCATION: Near lagoon
Southern Well

OWNER: U.S. EPA
 ADDRESS: Skinner Landfill
West Chester, OH
 TOTAL DEPTH 42.0'

SURFACE ELEVATION: 731.51'

WATER LEVEL: _____

DRILLING COMPANY: Moore
 DRILLER: F. Moore

DRILLING METHOD: HSA coring DATE DRILLED: 5/20/86
 HELPER: Bill

LOG BY: P. Bartz

SKETCH MAP

NOTES:

DEPTH (FEET)

GRAPHIC LOG

SAMPLE NUMBER
 SAMPLE TYPE
 SAMPLE BLOWS

DESCRIPTION / SOIL CLASSIFICATION
 (COLOR, TEXTURE, STRUCTURES)

S-9 SS 7
 4

S-10 SS 10
 9
 9

S-11 15
 16
 9

S-12 7
 7
 12

S-13 12
 22
 21

S-14 SS 11
 17
 19

S-15 SS 10
 29
 33

S-16 SS 20
 22
 18

Gray silty clay to clayey, sandy gravelly silt with interbedded fine to coarse-grained sand and fine gravels and some thin clay layers, very stiff to hard (cl-mi, gm, gc).

40.0'

DRILLING LOG

WELL NUMBER: SLGW19 OWNER: U.S. EPA
 LOCATION: near lagoon ADDRESS: Skinner Landfill
(Southern WeH)
 TOTAL DEPTH: 42.0'
 SURFACE ELEVATION: 731.51' WATER LEVEL: _____
 DRILLING COMPANY: Moore DRILLING METHOD: HSA drilling DATE DRILLED: 5/20/86
 DRILLER: F. Moore HELPER: P. H.
 LOG BY: P. Bartz

SKETCH MAP

NOTES:

DEPTH (FEET)

GRAPHIC LOG

SAMPLE NUMBER

SAMPLE TYPE

SAMPLE BLOWS

DESCRIPTION / SOIL CLASSIFICATION
(COLOR, TEXTURE, STRUCTURES)

5-17 SS

27
35
12

Gray limestone.

42.0'

END OF BORING

Client: Skinner PRP Group
 Project: Skinner RDI
 Location: West Chester, Ohio

Project No: 72680.300

LOG OF BORING NO. GW-51

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (Inches)	FID (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE	
						745.3 (ft.)	10	20	30	80	80		80
		Light yellowish brown (2.5y 6/4) SILT, 20% angular gravel, 10% sand, very stiff, dry.	SS	8	0.2								24
		Same, hard.	SS	5	1.8								38
5		Same with 30% gravel, very hard.	SS	8	1.8	740.3							100
		No recovery.	SS	NR	ND								100
		Same, hard.	SS	10	1.8								33
10		Same, 50% gravel, very hard.	SS	2	1.8	735.3							100
		Light yellowish brown (2.5y 6/4) well graded SAND, 10% angular gravel, 5% silt, medium dense, dry. (FILL)	SS	5	1.9								17

DATE STARTED: 10-27-94	DATE FINISHED: 10-27-94	NOTES: SS = Split Spoon Sample NR = No Recovery ND = No Data Available FID background is 20 ppm
DRILLING METHOD: 4-1/4" ID Hollow Stem Auger		
GEOLOGIST: S. Poole	DRILLER: J. Murphy	
WATER LEVEL: --		

DATE STARTED: 10-27-94

DATE FINISHED: 10-27-94

DRILLING METHOD: 4-1/4" ID Hollow Stem Auger

GEOLOGIST: S. Poole

DRILLER: J. Murphy

WATER LEVEL: --

NOTES:

SS = Split Spoon Sample
 NR = No Recovery
 ND = No Data Available
 FID background is 20 ppm

Client: Skinner PRP Group
 Project: Skinner RDI
 Location: West Chester, Ohio

Project No: 72680.300

LOG OF BORING NO. GW-51

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (Inches)	FID (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE
						745.3 (ft.) ₁	10	20	30	8080		
15		Light yellowish brown (2.5y 6/4) SILT, 30% gravel, 5% sand, very stiff, dry.	SS	4	1.8	730.3						28
		Same, 20% gravel, damp.	SS	4	2.0							17
		2" same, 2" limestone rock, damp.	SS	5	1.8							40
20		Yellowish brown (10yr 5/6) SILT, 30% sand, 20% gravel, very stiff, moist. Bag sample taken from 18-22 ft.	SS	7	2.0	725.3						17
		No recovery.	SS	NR	ND							100
		No recovery.	SS	NR	ND							100
25		Yellowish brown (10yr 5/4) well graded SAND, 10 % gravel, 5% silt, medium dense, damp.	SS	10	1.0							21
		Same. 2" Moist silt with 10% fine sand at 27.2 ft.	SS	10	0.8							22

Client: Skinner PRP Group
 Project: Skinner RDI
 Location: West Chester, Ohio

Project No: 72880.300

LOG OF BORING NO. GW-51

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (inches)	FID (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)				N VALUE
						745.3 (ft.)	10	20	30	8080	
		Limestone gravel, dry.	SS	2	1.0						100
		Yellowish brown (10yr 5/4) well graded GRAVEL, 30% silt, 20% sand, moist.	SS	3	0.7						28
35		2" Pulverized limestone. 10" Poorly graded, medium to coarse sand, 1% fine gravel, damp.	SS	12	0.8	710.3					31
		No recovery.	SS	NR	ND						100
		1" Limestone gravel, gley (5/5gy) well graded GRAVEL, 30% clay, 10% sand, 10% silt. moist.	SS	13	0.8						38
40		2" Well graded SAND, 30% sub- rounded gravel, 5% silt, moist.				705.3					?
		No recovery.	SS	NR	ND						
		2" Limestone gravel. 4" Gray (5y 5/1) CLAY, 7% rounded gravel, 5% silt, damp. (TILL)	SS	8	0.4						100
45		Light yellowish brown (2.5y 6/4) CLAY with 5% gray mottling, 20% gravel, 5% silt, 5% sand in seams, low plasticity, hard, moist.	SS	8	2.5	700.3					38

Client: Skinner PRP Group
 Project: Skinner RDI
 Location: West Chester, Ohio

Project No: 72880.300

LOG OF BORING NO. GW-51

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (Inches)	FID (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE
						745.3 (ft.) ₁	10	20	30	8080		
		7" Gray (2.5y 5/1) poorly graded fine SAND, 40% silt, 2% rounded gravel, wet.	SS	15	10							7
		8" Gray (2.5y 5/1) CLAY, 5% rounded gravel, 5% silt, medium plasticity, wet.										
		6" Gray (2.5y 5/1) and light yellowish brown (2.5y 6/4) mottled, same, damp.	SS	8	9.5							38
50		Light yellowish brown (2.5y 6/3), poorly graded, medium SAND, damp.				895.3						
		Light brownish gray (2.5y 6/2) well graded SAND, 10% rounded gravel, 5% silt, damp.	SS	5	8.2							100
		1" Limestone										
		11" Light olive brown (2.5y 5/3) poorly graded, fine SAND, 10% silt, 5% gravel, wet.	SS	12	50.2							32
55		Grayish brown (2.5y 5/2), poorly graded, medium to coarse SAND, 2% gravel, wet.	SS	8	280	890.3						32
		Same, saturated.										
			SS	8	300							52
		15" Light brownish gray (2.5y 6/2) well graded SAND, 20% silt, 10% gravel, saturated.										
		9" Gray (2.5y 5/1) well graded SAND, saturated.	SS	24	30							38
80		2" Same.				885.3						
		3" Gray (2.5y 5/1) CLAY, 10% gravel, moist. (TILL)	SS	7	100							100

Client: Skinner PRP Group
 Project: Skinner RDI
 Location: West Chester, Ohio

Project No: 72880.300

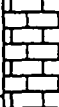
LOG OF BORING NO. GW-51

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (Inches)	FID (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE
						745.3 (ft.) ₁	10	20	30	8080		
		Gray (2.5y 5/1) poorly graded, coarse to very coarse, rounded SAND, 10% rounded gravel, 5% clay. Clayey layers (30% clay) at 62.8 and 63.5 ft., saturated. Bottom	SS	24	8							38
85		4" CLAY with 10% gravel, medium plasticity, moist. (TILL) Light olive brown (2.5y 5/4) same, 5% gray mottles, moist.	SS	5	12	880.3						83
			NS	NS	ND							ND
		Very coarse SAND with 5% fine rounded gravel, grades to poorly graded GRAVEL with 20% sand, saturated.	SS	10	2.8							17
70		Gray (5y 5/1) CLAY, 10% rounded gravel, 10% coarse sand, damp. (TILL)	SS	4	7.2	875.3						22
		Same, damp.	SS	8	13							88
		Same with 3% rounded gravel, high plasticity, damp. (TILL)	SS	5	8.5	870.3						50
75		Same, moist.	SS	3	29							71
		Crushed LIMESTONE. Some of the pieces show mineral staining.	Core	8	ND							

Client: Skinner PRP Group
 Project: Skinner RDI
 Location: West Chester, Ohio

Project No: 72680.300

LOG OF BORING NO. GW-51

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (inches)	FID (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE
						745.3 (ft.) ₁	10	20	30	60	80	
			Core	8	NO							NO
80		Boring terminated at 79.2 ft.				885.3						
85						880.3						
90						855.3						

Client: Skinner PRP Group
 Project: Skinner RDI
 Location: West Chester, Ohio

Project No: 72680.300

LOG OF BORING NO. GW-52

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (Inches)	FID (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE
						888.3 (ft.)	10	20	30	80	80	
		Dark grayish brown (10yr 4/2) SILT, 10% fine sand, 10% clay, organic matter, damp.	SS	3	0.1							17
		Yellowish brown (10yr 5/8) poorly graded, fine to medium SAND, 40% gravel, 10% silt, dry.	SS	10	0.1							48
5		5" Same. 4" Dark gray SILT, 10% clay, 5% sand, 5% fine gravel, moist.	SS	9	ND	881.3						17
		Dark gray (5y 4/1) poorly graded, fine to medium SAND, 40% gravel, 20% silt, moist. Bag sample taken from 6-8 ft.	SS	4	0.1							14
10		Gley (5/5gy) CLAY, 20% silt, 5% fine to medium rounded gravel, low sphericity, 5% black laminae, high plasticity, moist. (TILL) Bag sample taken from 8-10 ft.	SS	8	0.1							18
		No recovery.	ST	NR	ND	878.3						
		Same.	SS	12	1.8							18

DATE STARTED: 10-13-94

DATE FINISHED: 10-13-94

DRILLING METHOD: 4-1/4" ID Hollow Stem Auger/ HQ Core

GEOLOGIST: S. Poole

DRILLER: J. Murphy

WATER LEVEL: --

NOTES:

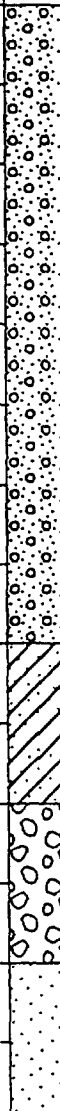
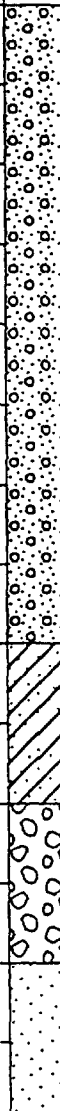
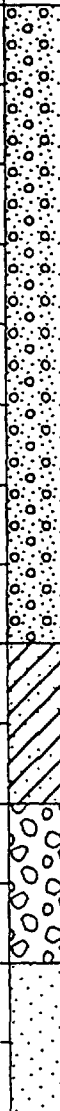
SS = Split Spoon Sample
 NR = No Recovery
 ND = No Data Available
 ST = Shelby Tube Sample
 FID background is 10 ppm

Client: Skinner PRP Group
 Project: Skinner RDI
 Location: West Chester, Ohio

Project No: 72880.300

LOG OF BORING NO. GW-52

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (inches)	FID (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)				N VALUE
						886.3 (ft.) ₁	10	20	30	8080	
15		Same, with no laminae, 2% orange mottling, damp.	SS	5	5.0	871.3					30
		Same with very thin sand seam at 17.6 ft., damp.	SS	9	1.8						30
		Gley (5/10y) CLAY, 30% silt, 5% fine to medium gravel, rounded, spherical, high plasticity, dry. Bag sample taken from 18-20 ft. (TILL)	SS	11	5.5						40
20		Same.	SS	11	4.0	886.3					48
		Same with very thin sand seam at 23.5 ft.	SS	13	11						45
		Same, damp.	SS	15	4	881.3					28
25		Same, no mottling, damp.	SS	8	0.2						88
		HQ rock coring begins at 27.4 ft. No recovery.	CORE	NR	ND						
		Boring terminated at 29.4 ft.									

Client: Skinner PRP Group Project: Skinner ROI Location: West Chester, Ohio						Project No: 72880.300						LOG OF BORING NO. B-62					
DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (Inches)	PID (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE					
						730.2 (ft.)	10	20	30	8080							
5		2" Dark brown CLAY, 30% silt, 10% fine gravel, moist.	SS	18	1.0	725.2							15				
		2" Yellow brown, poorly graded GRAVEL, 20% silt, 20% sand, damp.															
		14" Pale yellow, poorly graded sand, dry.	SS	12	1.0										31		
		Yellow gray, well graded SAND, 40% gravel, 10% silt, hard, dry. Gravel angular. Bag sample taken from 4-8 ft.															
10		Yellow gray, well graded SAND, 30% gravel, 15% silt, hard, dry.	SS	8	1.0	720.2								34			
		No recovery.															
		Yellow brown CLAY, 40% SAND, 10% fine gravel, 5% silt, stiff, damp.	SS	NR	ND										40		
15		1" Well graded angular gravel, 20% sand, 5% silt, very stiff, dry.	SS	8	1.3	715.2								14			
		1" Black CLAY, 20% sand, moist.															
		4" Olive with black mottles, poorly graded SAND with 30% gravel, 5% silt, saturated.	SS	12	1.0										23		
		4" Same, olive, moist.															
		Boring terminated at 14 ft.												13			

DATE STARTED: 10-20-94	DATE FINISHED: 10-20-94	NOTES: SS = Split Spoon Sample NR = No Recovery ND = No Data Available PID background is 10 ppm
DRILLING METHOD: 4-1/4" ID Hollow Stem Auger		
GEOLOGIST: S. Poole	DRILLER: J. Murphy	
WATER LEVEL: --		

Client: Skinner PRP Group
 Project: Skinner RDI
 Location: West Chester, Ohio

Project No: 72880.300

LOG OF BORING NO. B-69

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (inches)	PID (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)				N VALUE
						888.4 (ft.)	10	20	30	8080	
		Brown clay, 30% silt, plastic, stiff, moist.	SS	8	BG						12
		Top 5" same. Bottom 5" Gray CLAY, 20% silt, trace fine gravel, plastic, very stiff, moist. (TILL)	SS	10	BG						18
5		Gray SILT, trace fine gravel, non-plastic, very stiff, moist. (TILL) 1" Silt and fine sand layer.	SS	11	BG	881.4					25
		Gray SILT, 20% clay, slightly plastic, stiff, damp. (TILL)	SS	10	BG						20
		Same. Bag sample taken.	SS	10	BG						20
10		Gray SILT, 10% clay, non-plastic, hard, damp. (TILL)	SS	8	BG	878.4					38
		Same.	SS	10	BG						38

DATE STARTED: 11-18-94

DATE FINISHED: 11-18-94

DRILLING METHOD: 4-1/4" ID Hollow Stem Auger/ HQ Core

GEOLOGIST: K. Heaton

DRILLER: J. Murphy

WATER LEVEL: 20 ft. on 11-18-94







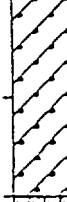
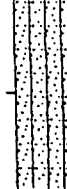
NOTES:

SS = Split Spoon Sample
 ND = No Data Available
 BG = Background
 PID background is 0.8 ppm
 ∇ = Initial Water Level

Client: Skinner PRP Group
 Project: Skinner RDI
 Location: West Chester, Ohio

Project No: 72880.300

LOG OF BORING NO. B-69

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (inches)	PID (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)				N VALUE
						888.4 (ft.) ₁	10	20	30	6080	
15		Same, trace medium sand. Methane detected in augers.	SS	10	BG	871.4					25
		Coarse SAND and fine gravel. 40% fines, dense, damp.	SS	8	BG						45
		Gray CLAY, trace fine gravel, plastic, stiff, moist. (TILL)	SS	18	BG						12
20		Gray coarse SAND and fine gravel, 20% fine sand, medium dense, saturated.	SS	11	BG	888.4					22
		Gray medium SAND, 20% coarse sand and fine gravel, 25% fine sand, dense, saturated.	SS	7	BG						34
25		Gray CLAY, trace coarse gravel, trace coarse sand, hard, damp. (TILL)	SS	5	BG	881.4					38
		Gray soft CLAY, silt, fine to coarse sand, fine gravel, saturated. (TILL)	SS	7	BG						15
		Gray SILT, 10% coarse sand, non- plastic, medium dense, saturated.	SS	10	BG						11

Client: Skinner PRP Group
 Project: Skinner RDI
 Location: West Chester, Ohio

Project No: 72680.300

LOG OF BORING NO. B-69

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (Inches)	PID (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE
						888.4 (1ft.)		10	20	30	8080	
		Gray SILT and coarse sand, very stiff, saturated.	SS	10	BG							33
		Gray SILT, trace organics, non-plastic, stiff, saturated.	SS	13	BG							8
		Same.										
35			SS	12	BG	851.4						8
		Same. Lower 2" is fine to medium angular gravel.	SS	11	BG							100
		Gray fossiliferous LIMESTONE interbedded with gray calareous weathered shale. No sign of fracturious, low permability, low porosity.	Core	10	BG							100
40		Boring terminated at 40 ft.				848.4						
45						841.4						

Client: Skinner PRP Group
 Project: Skinner RDI
 Location: West Chester, Ohio

Project No: 72880.300

LOG OF BORING NO. B-70

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (inches)	PID (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE
						707.8 (ft.)	10	20	30	8080		
		Tan, medium SAND, 30% silt, 15% coarse SAND, dense, damp.	SS	12	BG							32
		Brown CLAY, 20% silt, plastic, very stiff, moist.	SS	8	BG							18
5		Brown CLAY, fine to coarse gravel, plastic, stiff, moist.	SS	2	BG	702.8						12
		Brown CLAY, 20% silt, 10% fine gravel, plastic, moist, At 7' becomes olive brown SILT, 20% clay, 20% fine gravel, very stiff, saturated.	SS	18	BG							18
		No sample.	NS	NS	NS							
10		Olive brown SILT, 20% clay, 20% fine gravel, very stiff, saturated.	SS	8	BG	897.8						17
		Brown coarse SAND, 15% fine sand, 5% fine gravel, medium dense, saturated.	SS	10	BG							23
15		Gray SILT, 35% limestone chips, very stiff, damp.	SS	4	BG	892.8						17
		Gray fine SAND, trace fine gravel, wet. Lower 2" is gray till.	SS	4	BG							30

DATE STARTED: 11-16-94	DATE FINISHED: 11-17-94	NOTES: SS = Split Spoon Sample NS = No Sample BG = Background PID background is 0.2 ppm /A = Initial Water Level
DRILLING METHOD: 4-1/4" ID Hollow Stem Auger/ HQ Core		
GEOLOGIST: K. Heaton	DRILLER: J. Murphy	
WATER LEVEL: 7 ft. on 11-16-94		

DATE STARTED: 11-18-94

DATE FINISHED: 11-17-94

DRILLING METHOD: 4-1/4" ID Hollow Stem Auger/ HQ Core

GEOLOGIST: K. Heaton

DRILLER: J. Murphy

WATER LEVEL: 7 ft. on 11-18-94

NOTES:

SS = Split Spoon Sample

NS = No Sample

BG = Background

PID background is 0.2 ppm

/A = Initial Water Level

Client: Skinner PRP Group
 Project: Skinner RDI
 Location: West Chester, Ohio

Project No: 72680.300



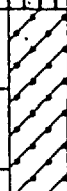
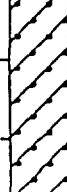


LOG OF BORING NO. B-70

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (inches)	PID (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE
						707.8 (ft.) ₁	10	20	30	60	80	
			SS	4	BG							
		Gray SILT and fine sand, trace fine gravel, crumbly hard, damp.	SS	8	BG							100
20		Gray medium SAND, 40% silt, moist. Lower 2" is till, damp.	SS	5	BG	887.8						100
		Gray TILL, hard, damp.	SS	ND	BG							4
25		Gray TILL, damp. Lower 1" is silt, hard, moist.	SS	18	BG	882.8						100
		Gray TILL, hard, damp. 6" Coarse SAND, dense, wet.	SS	12	BG							39?
		Gray coarse SAND, dense, saturated.	SS	14	BG							
30		Same. Lower 8" is TILL, hard, damp.	SS	14	BG	877.8						31
		TILL with trace pieces of shale, damp.	SS	12	BG							52
		TILL, same, damp.	SS	11	BG	872.8						100
35		TILL, same, damp.	SS	12	BG							100

Client: Skinner PRP Group
 Project: Skinner RDI
 Location: West Chester, Ohio

Project No: 72880.300

LOG OF BORING NO. B-70

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (inches)	PTD (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE		
						707.8 (ft.) ₁	10	20	30	8080				
40		Gray TILL.	SS	12	BG	887.8							100	
			SS	0	BG									
45		Gray SILT and medium SAND, 20% coarse sand, 5% fine gravel, non-plastic, hard, damp.	SS	8	BG	882.8							100	
			SS	10	BG									
		TILL, damp.	SS	10	BG									100
			NS	NS	NS									
50		Limestone pieces in tip. at shoe.	SS	1	BG	857.8							100	
			SS	8	BG									41
		Black fine SAND, 30% silt, dense, saturated. No petroleum odor.	SS	8	BG									
			SS	8	BG									
55		Gray with a trace of black, fine SAND and SILT, saturated.	SS	24	BG	852.8							27	
			SS	24	BG									48
		Gray SILT, non-plastic, hard, saturated.	SS	24	BG									
			SS	24	BG									
60		Angular gray LIMESTONE fragments, sand, and gravel, very dense, wet.	SS	8	BG	852.8							100	
			SS	8	BG									41
		Gray fossiliferous LIMESTONE fragments, silt, sand, and gravel, very dense, wet.	SS	8	BG									
			SS	8	BG									
65		Same.	SS	4	BG									
			SS	4	BG									

Client: Skinner PRP Group
 Project: Skinner RDI
 Location: West Chester, Ohio

Project No: 72680.300

LOG OF BORING NO. B-70

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	RECOVERY (Inches)	PIO (ppm)	ELEV. (MSL)	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE
						707.8 (ft.) ₁	10	20	30	8080		
			SS	4	BG							100
80		Gray fossiliferous LIMESTONE with interbedded gray calcareous shale. No evidence of weathering or fracturing. Low permeability and low porosity.	Cqre	33.5	BG	847.8						NO
		Boring terminated at 62 ft.										
85						842.8						
70						837.8						
75						832.8						

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Did NWB handle barrels or drums from this entity? Indicate yes (Y), no (N), or don't know (DK):

If yes, please answer to the best of your knowledge and belief. If you don't know, indicate by placing DK in the box. If more room is needed, please continue your response on an addition sheet of paper and attach:

ENTITY NAME:	Y, N, or DK	How much/ how often: (e.g. 5 barrels per week)	What years:	Nature of residue in barrels:	Disposition of barrels after delivery to NWB:	Other comments or recollections:
61. JI Case Corp/ Racine, WI	Y	1 or 2 times in 7 years	1959 to 1964	unknown	sent down conveyer to be worked over	
62. Globe-Union Milwaukee, WI	DK					
63. Kimberly Clark Corp.	DK					
64. Mautz Paint Co. Madison, WI	DK					
65. Nekoosa Edwards	DK					